ENGINEERING

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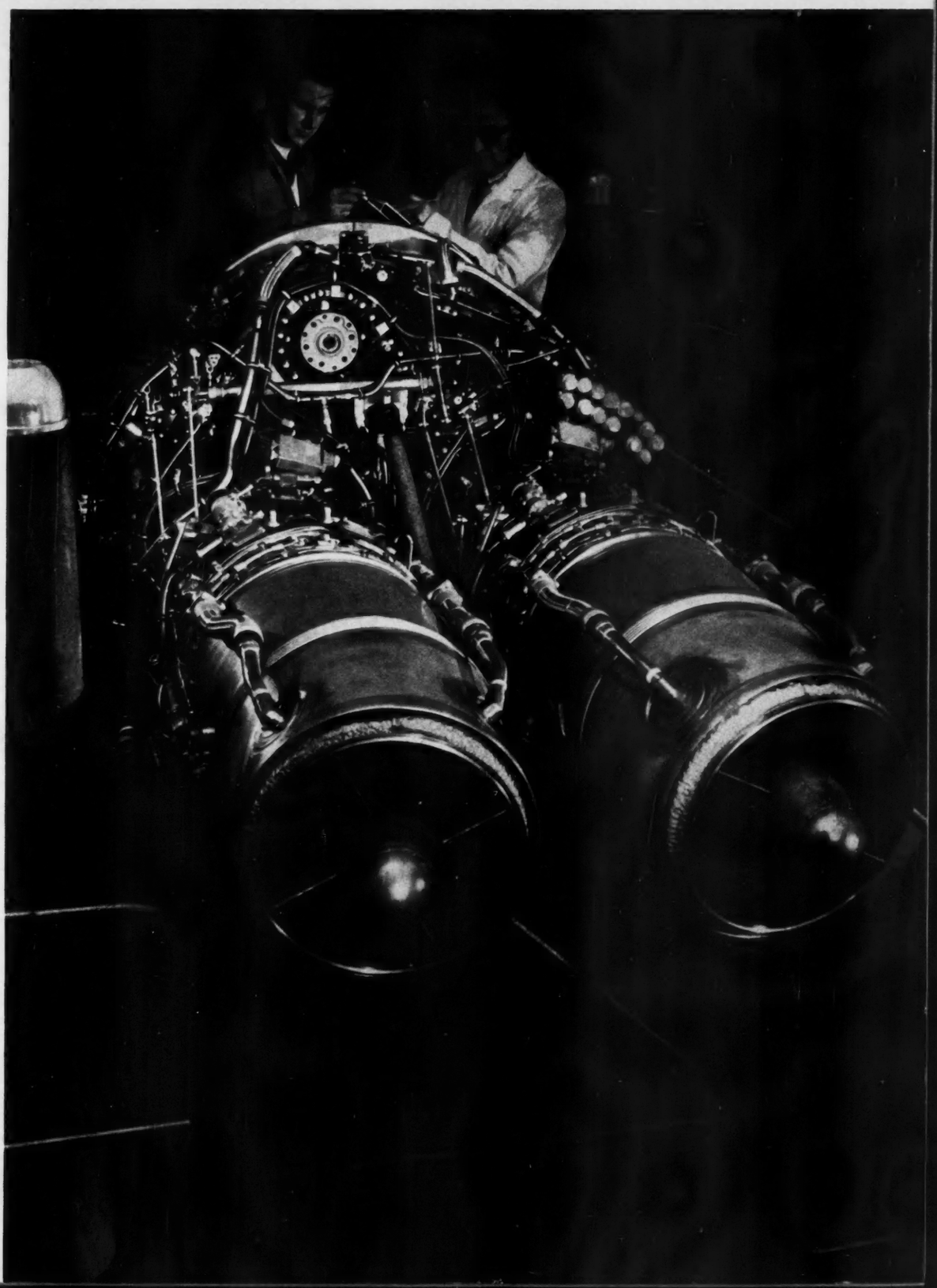
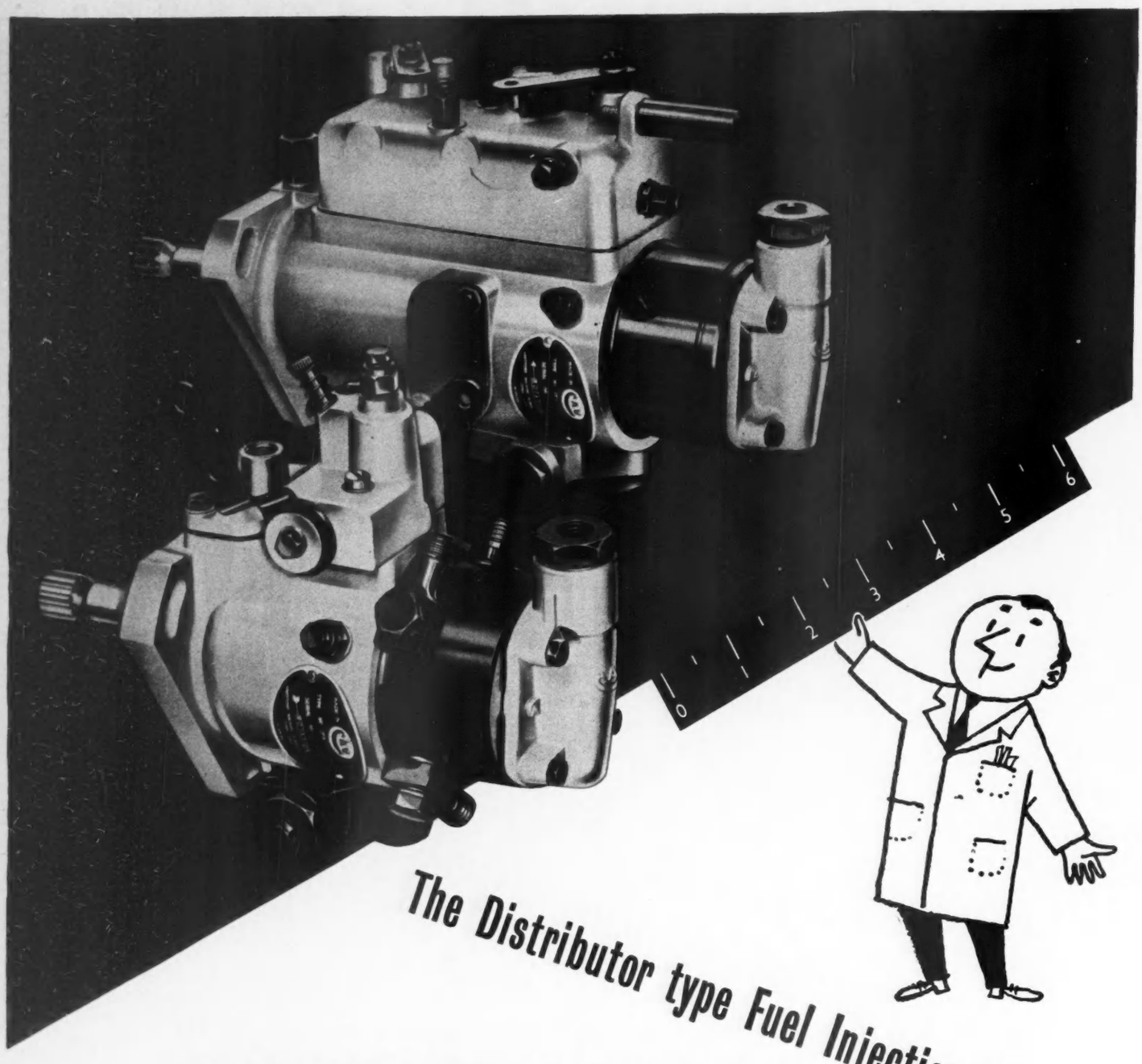


PRICE
2/-

Double Turboprop



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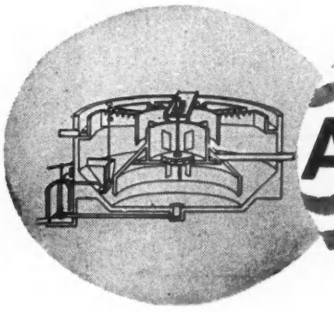

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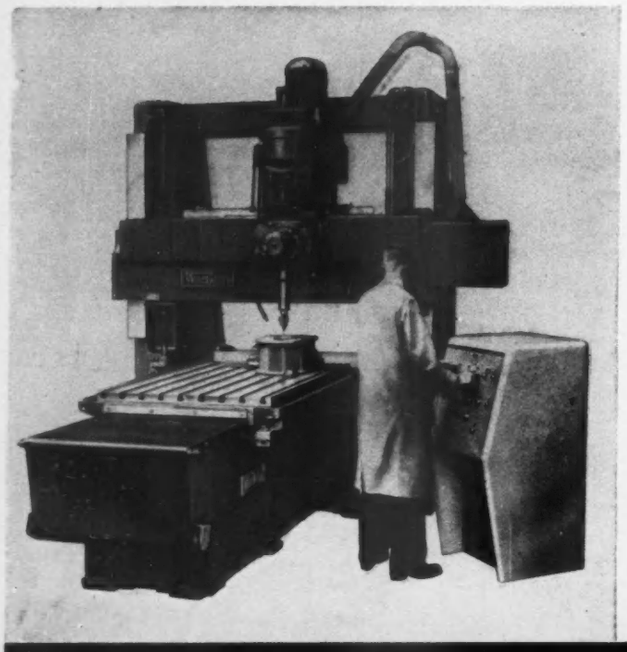

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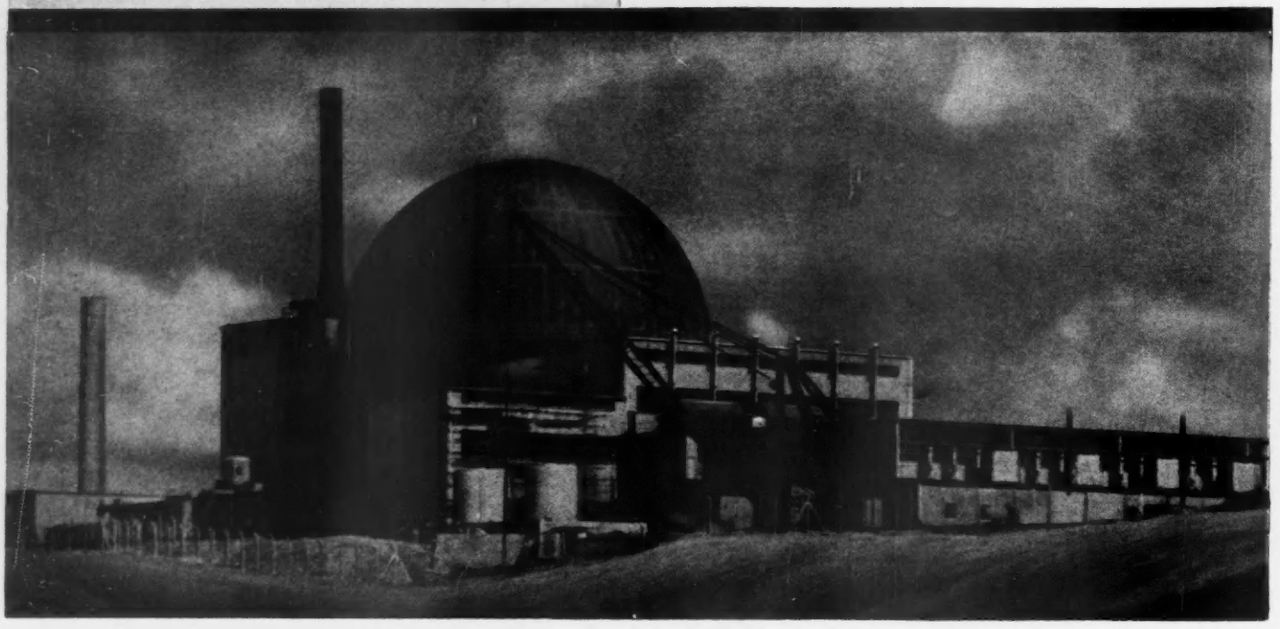

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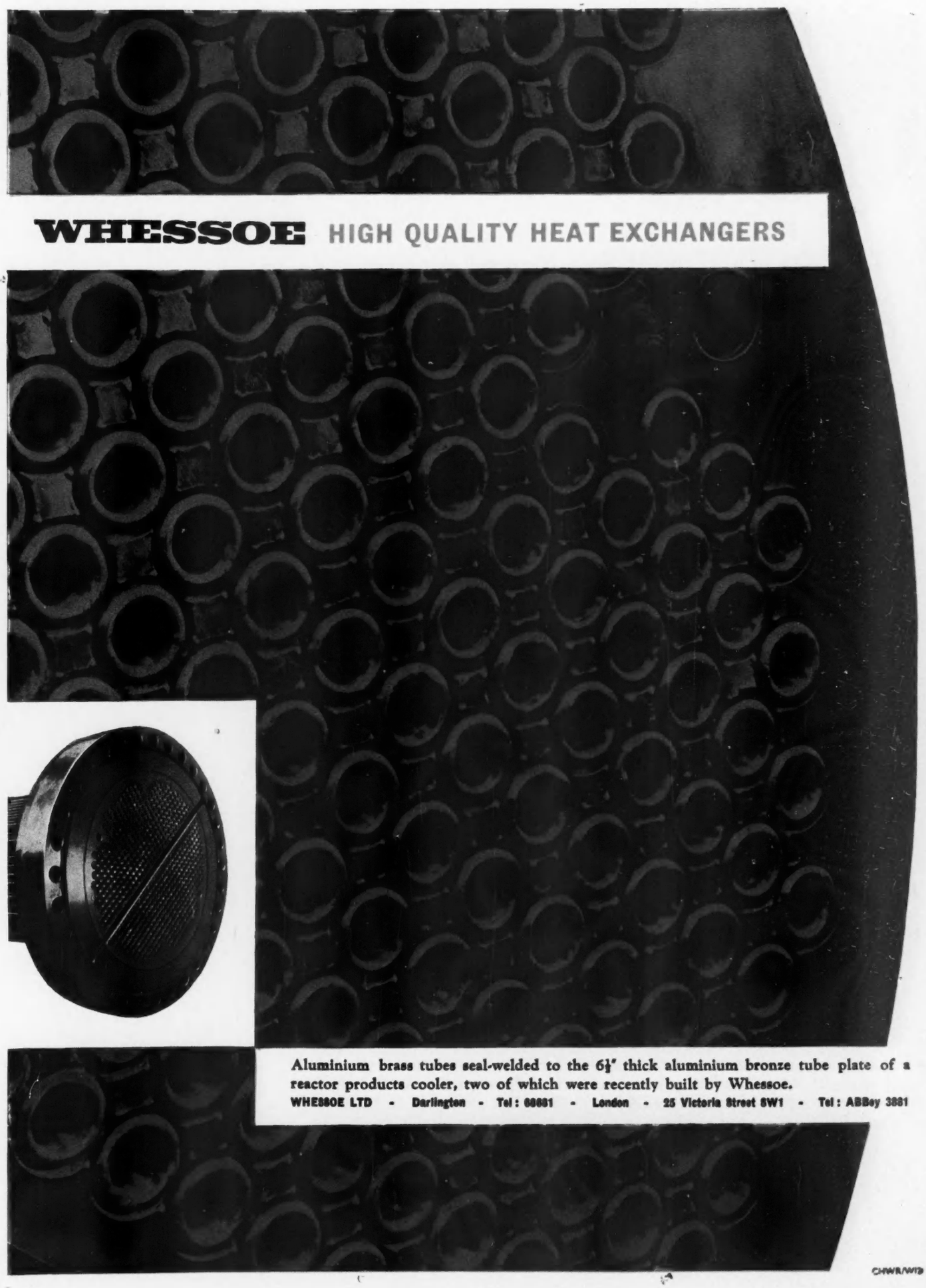

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7 October 1960

Vol. 190 No. 4929

Founded in 1866

ENGINEERING

PUBLISHED EVERY FRIDAY

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Contents

466 Metals and Materials

Improved Ptfe / Bronze Bearing Materials, Use Platinum-clad Steel and Save Money, Removal Agents, Quick Drying Red Lead Paint, Thick Coatings with Anodic Paint, 200 Miles of Stainless Tubing, Dispatch Quickly in Sticky Strawpaper, Starting Materials for Intermetallic Semi-conductors, Urethane Foam Keeps Out Dust, Protective Film for Graphite Ceramic

470 New Plant and Equipment

Drum Sander, Joints, Mobile Crane, Centrifugal Pumps, Recorder, Elapsed Time Indicator, Collator, Synchronous Timer, Cutting Machine, Power Pack, Circulating Pump, High Vacuum Valve

476 Construction

First Contract for the Severn Bridge, London's First Trav-o-lator Begins Operation, Metropolitan Water Board's 19 Mile Pressure Main

ASMT State 25 Soil Problems, New Structural Steel in USA, American Tyred Shovel on Road Work, Wind Station for Aluminium Building Units, Volta Dam Contract Next April, Flexibility of Pitch Pipes and Pipelines, Computer Library Programme, Joining Steel Beams and Concrete Columns

482 Production

Unit Construction Broaching Machine, Analogue Computer for Process Control, Pressed Loads Save Space, Measuring Levels with Moiré Fringes, Nailing in Half the Time, Pilot Brewery Automatically Controlled

484 Operation and Maintenance

Changing Centrifugal Pump Performance
By F. A. Varley

Automatic Coal Transfer from Wagon to Ship, Computers Prepare Statistics on People

490 Design

Pipe Branch Connections
By P. H. R. Lane

Marine Diesel Gives 18,350 b.h.p. from Ten Cylinders, Nylon Bonding in Sun and Planet Gear

494 Research and Development

Linking the World by Radio and Cable

Flexible Data Handling Unit for Industry, Importance of Space Research, Infra Red Gas Analyser

465 Impact

473 Human Element

481 Companies

489 Marketing

Special Articles

472 Ninth International Apprentices Competition

474 Computers Make Sense on Scale of Two
By David S. Evans

478 A National College for Future Foremen?

479 Atomic Review

Critical Control

493 Automobile Review

Even Smaller American Cars?
Edmonton Transit Steps on the Gas
New BMC Station Wagons

496 At Home

Designed to Help

468 Plain Words

By Capricorn

468 Letters to the Editor

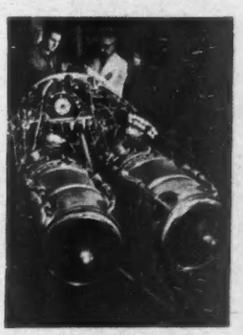
Mixing Gases
Boris N. Cole
Air Flow in Fruit Stores
J. C. Fidler
What to Read
C. W. Hanson
Radio's New Dimension
W. F. Hilton
Rain in Australia
Ronald A. Kirkin
Ultra Low Temperatures
W. Miller

469 Events in Advance

486 Publications

On the Shelf
By Frank H. Smith
A Treatise on Gyrostatics and Rotational Motion
Exploding Wires
British Shipping
Handbook of Industrial Research Management

New Books and Trade Publications



Cover Picture

Double Mamba turboprop mounted on a hydraulic servicing platform. (*Nurnberg photograph for* ENGINEERING)

The picture that appeared on the cover of the issue of 14 August was wrongly credited. The original photograph was in fact taken for an engineering company by John Mills (Photography) Limited.

Subscription Rates: Editorial page 496

Index to Advertisements: Overleaf

Engineering Appointments Section: Faces page 480

Advertisers in 'Engineering' this week

	PAGE
Apex, Ltd.	6
Allen, Edgar, & Co., Ltd.	29
Associated Electrical Industries, Ltd. Motor & Control Gear Division	63
Telecommunications Division	31
Automotive Products Co., Ltd.	57
Barclay, A., Sons & Co., Ltd.	12
Barimar, Ltd.	11
Bates Textiles (Manchester) Ltd.	78
Bennett, H. G., & Co. (Gloves) Ltd.	62
Blackstone & Co., Ltd.	9
Booth, Joseph, & Bros.	85
Bristol Siddeley Engines Ltd.	7
British Ermeto Corpn., Ltd.	5
British Iron & Steel Federation	50 & 51
British Paints, Ltd.	71
British Railways	79
British Ropeway Eng'g. Co., Ltd.	44
British Steam Specialties, Ltd.	53
British Twin Disc, Ltd.	72
Broadbent, Thomas, & Sons, Ltd.	68
Broom & Wade, Ltd.	38
Butterfield, W. F., Ltd.	10
C.A.V., Ltd.	*Wrapper* II
Carron Co.	85
Carruthers, J. H., & Co., Ltd.	55
Carter, B. & F., & Co., Ltd.	61
Chapman & Hall, Ltd.	4
Clyde Crane & Booth, Ltd.	85
Clyde Crane & Engineering Co.	85
Clyde Rubber Works Co., Ltd.	72
Cockburns, Ltd.	21
College of Aeronautics	5
Colt Ventilation, Ltd.	25
Colvilles, Ltd.	*Wrapper* VII
Contactor Switchgear, Ltd.	11
Conveyor & Elevator Co. (1936) Ltd.	10
Crofts (Engineers) Ltd.	40
Crosby Valve & Engineering Co., Ltd.	59
Daimler-Benz AG	52
Dempster, R., & Sons, Ltd.	65
Doncaster, D., & Sons, Ltd.	13
Elliston, Evans & Jackson, Ltd.	62
Engineering Industries Association	30
"Engineering" Reprints	4 & 9
English Numbering Machines, Ltd.	53
Eyre Smelting Co., Ltd.	12
Falk, Stadelmann & Co., Ltd.	41
Fenner, J. H., & Co., Ltd.	36 & 37
Fife Forge Co., Ltd.	62
Firth Brown Tools, Ltd.	*Wrapper* VI
Firth, Thos., & John Brown, Ltd.	86
General Electric Co., Ltd. of England	34 & 35
General Eng'g. Co. (Radcliffe) Ltd.	70
Glover, Wm. J., & Co., Ltd.	75
Goodyear Tyre & Rubber Co. (G.B.) Ltd.	48
Grafton Cranes, Ltd.	69
Greenwood & Batley, Ltd.	90
Head Wrightson Processes Ltd.	76
Heap, J., & Co., Ltd.	31
Hilton, R. B., Ltd.	23
Holmes, C. D., & Co., Ltd.	69
Hot Dip Galvanizers Association	88
Hudson, Robert, Ltd.	91
Hudswell, Clarke & Co., Ltd.	9
Imperial Aluminium Co., Ltd.	8
Imperial Chemical Industries Ltd. Fibres Division	15
Fluon Division	46
Industrial & Commercial Finance Corpn., Ltd.	*Wrapper* III
Industrial Pumps, Ltd.	83
Lambhill Ironworks, Ltd.	92
Levy, B., & Co. (Patterns) Ltd.	72
Lincoln Electric Co., Ltd.	39
Lister, R. A., & Co., Ltd.	9
Low, A., & Sons, Ltd.	42
McGraw-Hill Publishing Co., Ltd.	4
Manchester Furnaces, Ltd.	10
Marsden, S., & Son, Ltd.	78
Matterson, Ltd.	81
Matthew Hall & Co., Ltd.	33
Midland Silicones, Ltd.	82
Mond Nickel Co., Ltd.	60
Monk Bridge Iron & Steel Co.	13
Morgan Crucible Co., Ltd.	47
Moss Gear Co., Ltd.	*Wrapper* VIII
Mountford, Fredk. (B'ham) Ltd.	43
Mountford, J., & Co., Ltd.	79
National Industrial Fuel Efficiency Service	30
Newbury Diesel Co., Ltd.	78
Newton Chambers & Co., Ltd.	66 & 67
Norris Bros., Ltd.	9
Northey Rotary Compressors, Ltd.	5
Park Gate Iron & Steel Co., Ltd.	57
Parks Forge, Ltd.	9
Parsons, C. A., & Co., Ltd.	24
Paterson Engineering Co., Ltd.	*Wrapper* III
Peglers, Ltd.	78
Permali, Ltd.	89
Positive Lock Washer Co., Ltd.	72
Pratchitt Bros., Ltd.	83
Price Machine Guards Ltd.	4
Radiovisor Parent, Ltd.	27
Raybestos-Belaco, Ltd.	61
Reavell & Co., Ltd.	70
Reyrolle, A., & Co., Ltd.	28
Richardsons Westgarth (Hartlepool) Ltd.	72
Righton, H., & Co., Ltd.	20
Robson, G., & Co. (Conveyors) Ltd.	62
Rose, Downs & Thompson, Ltd.	45
Rotax, Ltd.	*Wrapper* IV
Rowen-Arc Division of Rubery, Owen & Co., Ltd.	65
Sankey Green Wire Weaving Co., Ltd.	80
Schiess AG.	17
Scott, Jas., Electronic Engineering, Ltd.	43
Scriven Machine Tools, Ltd.	53
Sealdraught, Ltd.	56
Sentinel (Shrewsbury) Ltd.	77
Serck, H. O., Ltd.	10
Simon, Richard, & Sons, Ltd.	54
Simon-Carves Ltd,	58
Slick Brands, Ltd.	31
Smith, J. (Keighley) Ltd.	49
Smith & McLean, Ltd.	69
Solartron Electronic Group, Ltd.	19
Spencer-Bonecourt-Clarkson, Ltd.	32
Stephens Belting Co., Ltd.	84
Sturtevant Engineering Co., Ltd.	14
Sunbeam Anti-Corrosives, Ltd.	13
T.A.L. Numatics, Ltd.	80
Tangyes, Ltd.	48
Taylor & Hubbard, Ltd.	61
Tecalemit, Ltd.	74
Technoexport	18
Terry, H., & Sons, Ltd.	77
Unicone Co., Ltd.	78
VEB Feinmesszeugfabrik Suhl	56
Venus Pencil Co., Ltd.	44
Verenigd Plastic - Verkoopkantoor N.V.	26
Visco Engineering Co., Ltd.	2
Wailes Dove Bitumastic, Ltd.	87
Ward, Thos. W., Ltd.	64
'Engineering' Appointments Section inside Editorial Section	
Allen, W. H., Sons & Co., Ltd.	4
Central Electricity Generating Board	2
Clive, Robert (Consultants) Ltd.	3
Delapena & Son, Ltd.	4
Fleming & British American Optical Industries, Ltd.	3
Imperial Smelting Corpn. Ltd.	4
Classified: Trade & Technical	
Bell, H. (Machine Tools) Ltd.	3
Central Electricity Generating Board	3
Cohen, Geo., Sons & Co., Ltd.	3
Wellman Bibby Co., Ltd.	71
Wellman Smith Owen Eng'g. Corpn., Ltd.	83
Wells, A. C., & Co., Ltd.	53
West Yorkshire Foundries, Ltd.	22
Wheesoe, Ltd.	*Wrapper* V
White, R., & Sons (Engineers) Ltd.	2
Whitehouse Industries, Ltd. (Phillidas Division)	73
Wilmot Breeden, Ltd.	16
Yarrow & Co., Ltd.	79
Yorkshire Imperial Metals, Ltd.	84
Zinc Development Association	88
Lucas, Joseph, Ltd.	3
Management Selection, Ltd.	1 & 2
Ministry of Power,	2
Morgan Crucible Co., Ltd.	1
National Institute for Research in Nuclear Science	2
Newton Chambers & Co., Ltd.	1
Edwards, F. J., Ltd.	3
Mayer, Newman & Co., Ltd.	3
Plint & Partners, Ltd.	3
Research Engineers, Ltd.	3

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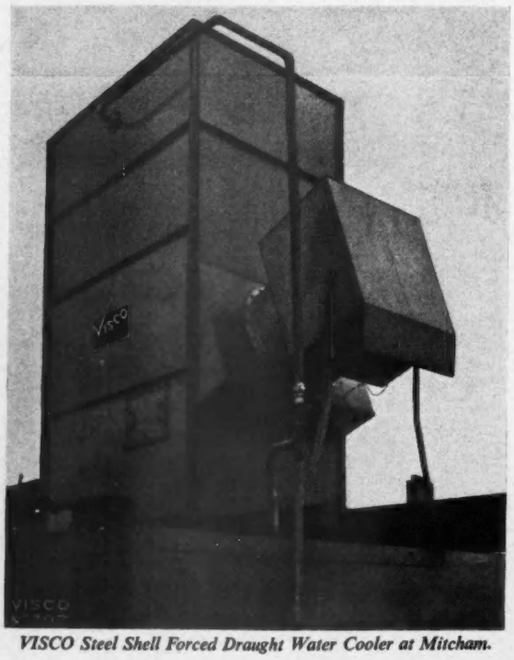

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D 108

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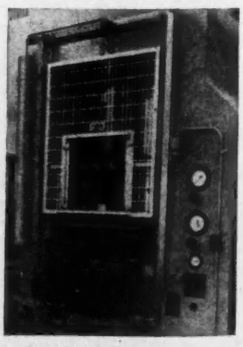

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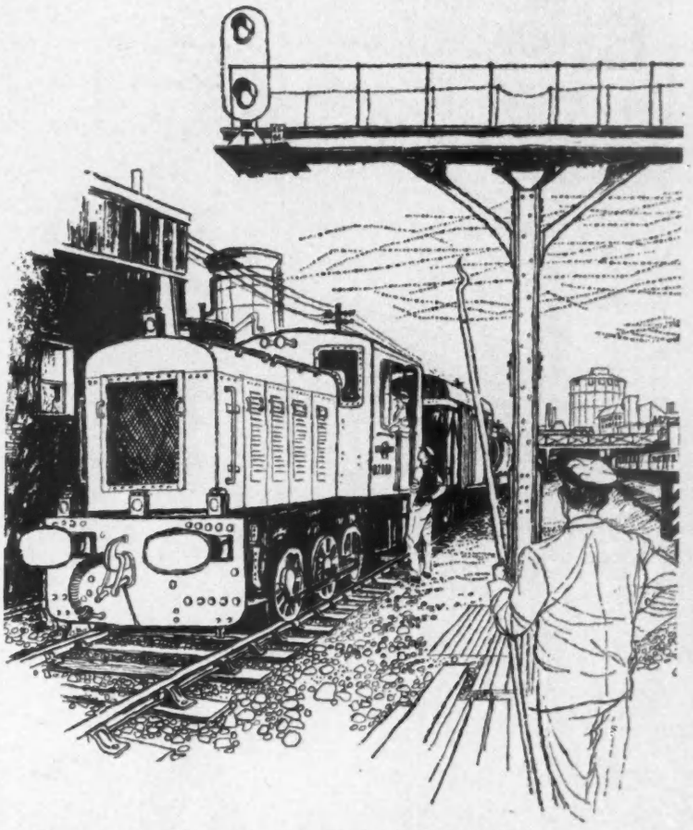

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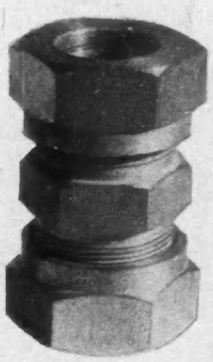

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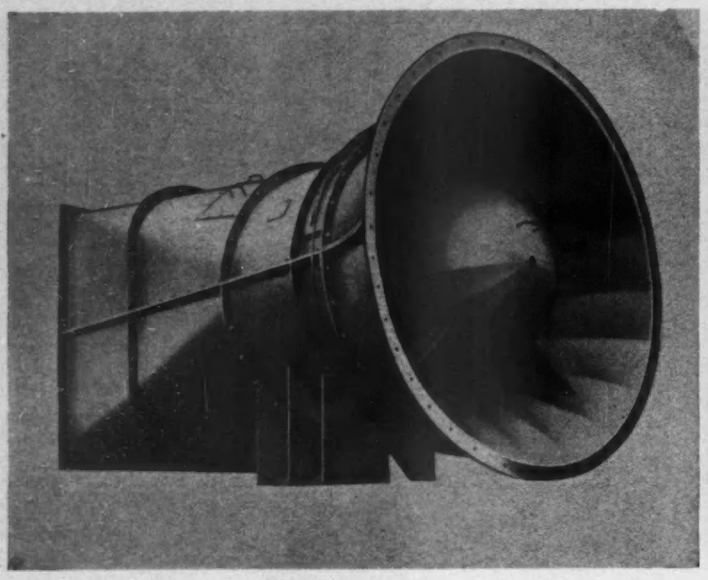

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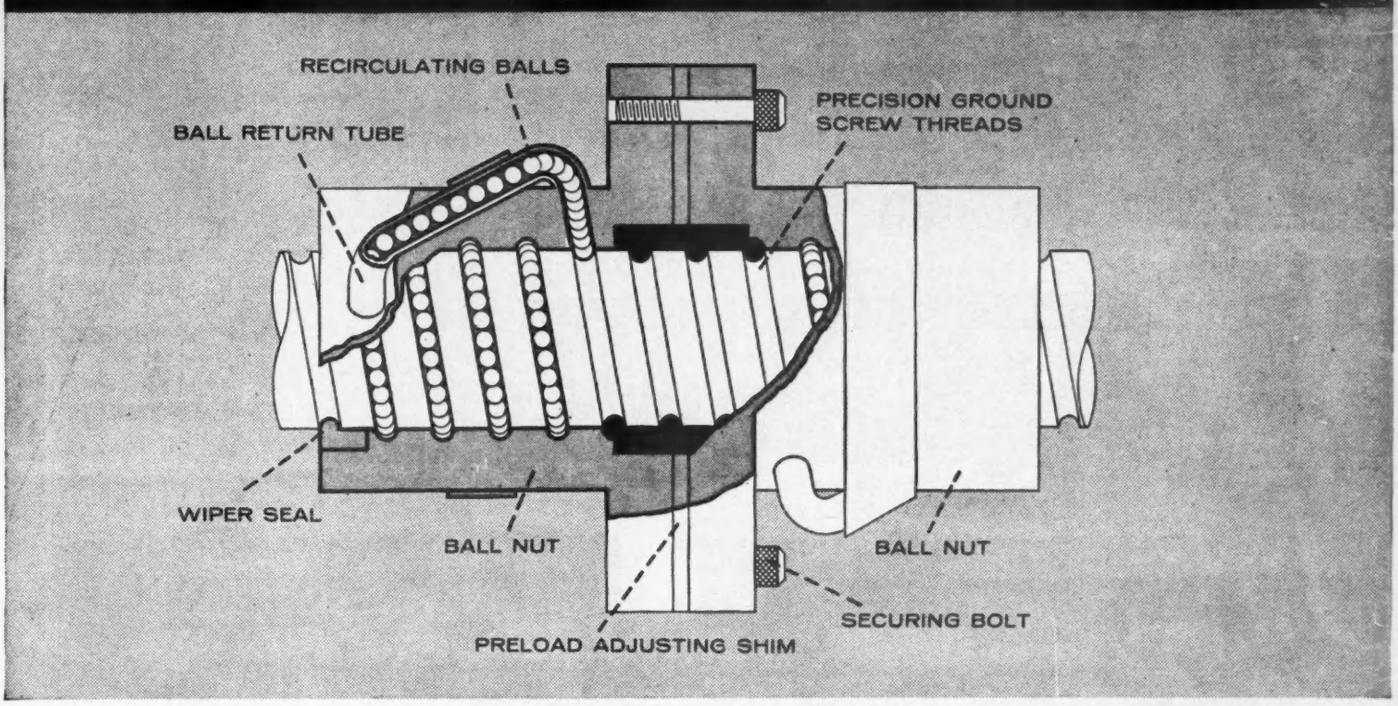

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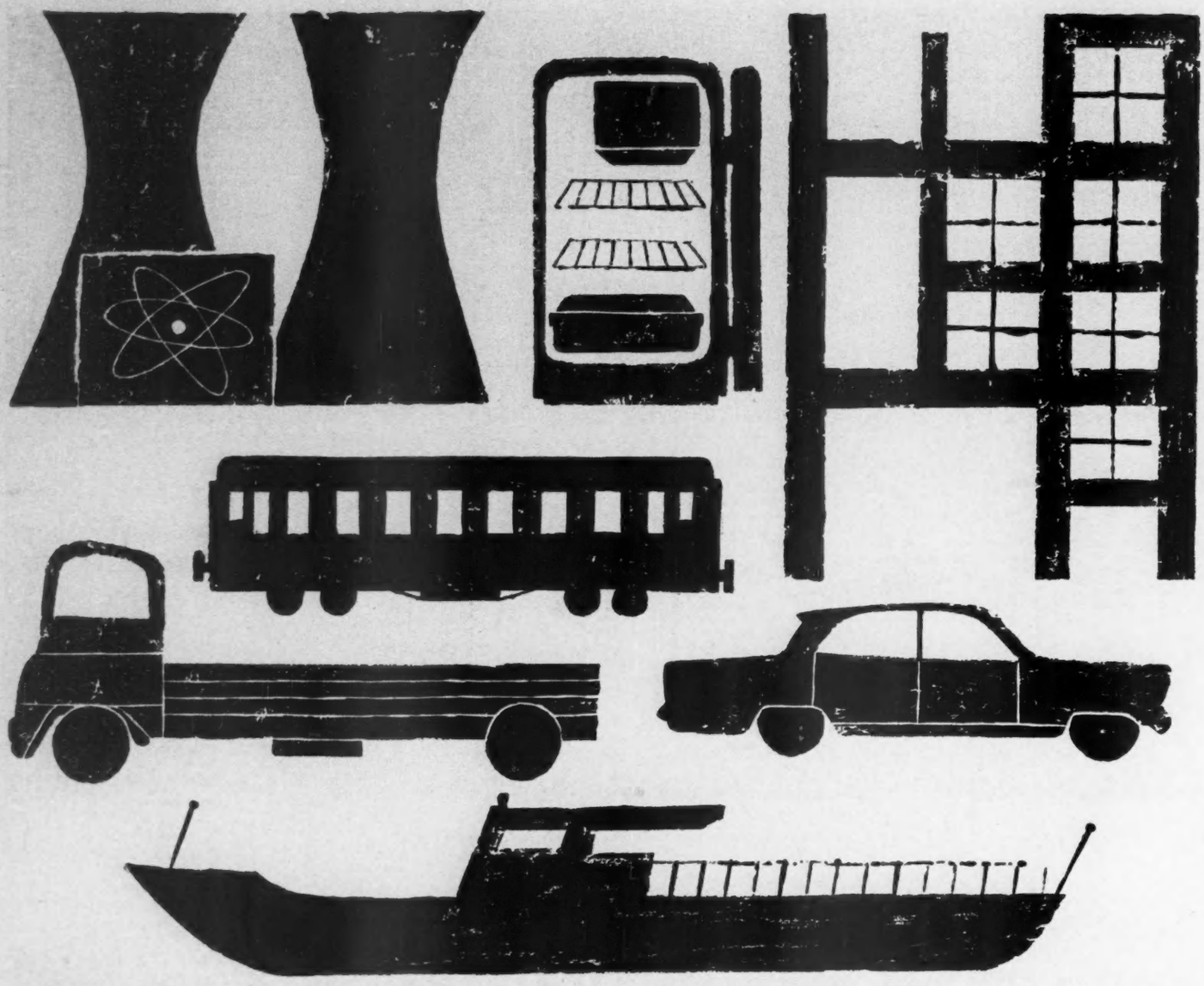

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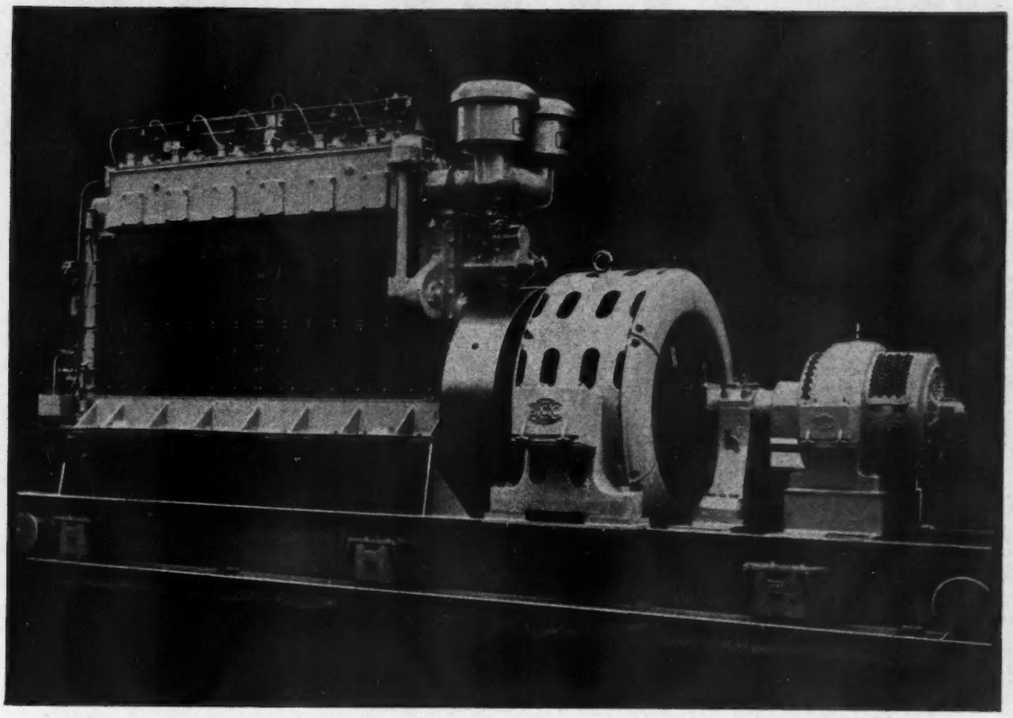

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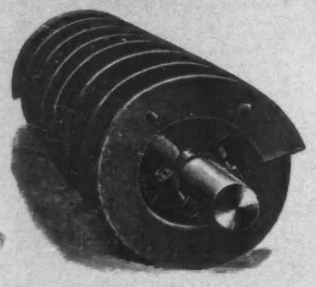

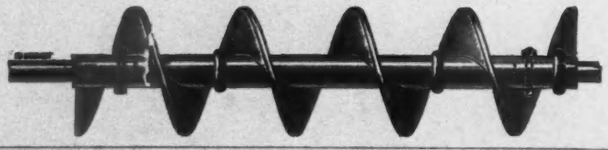

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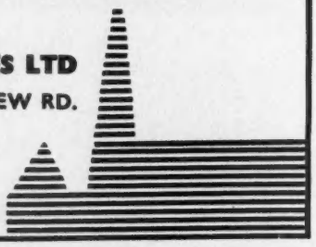

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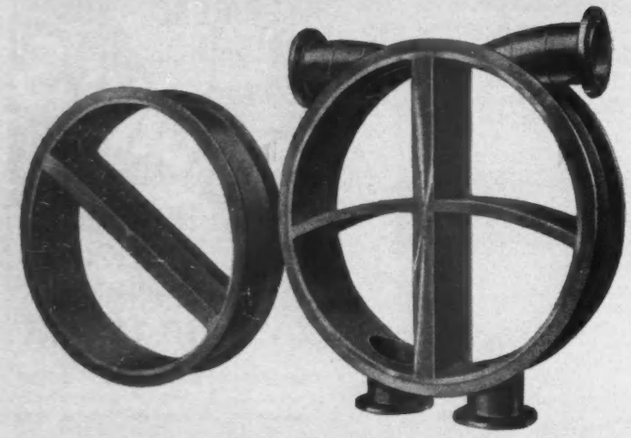

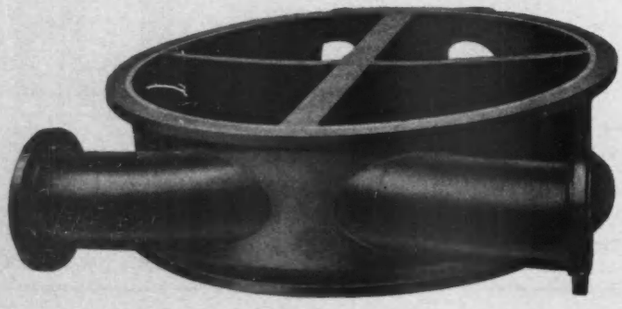

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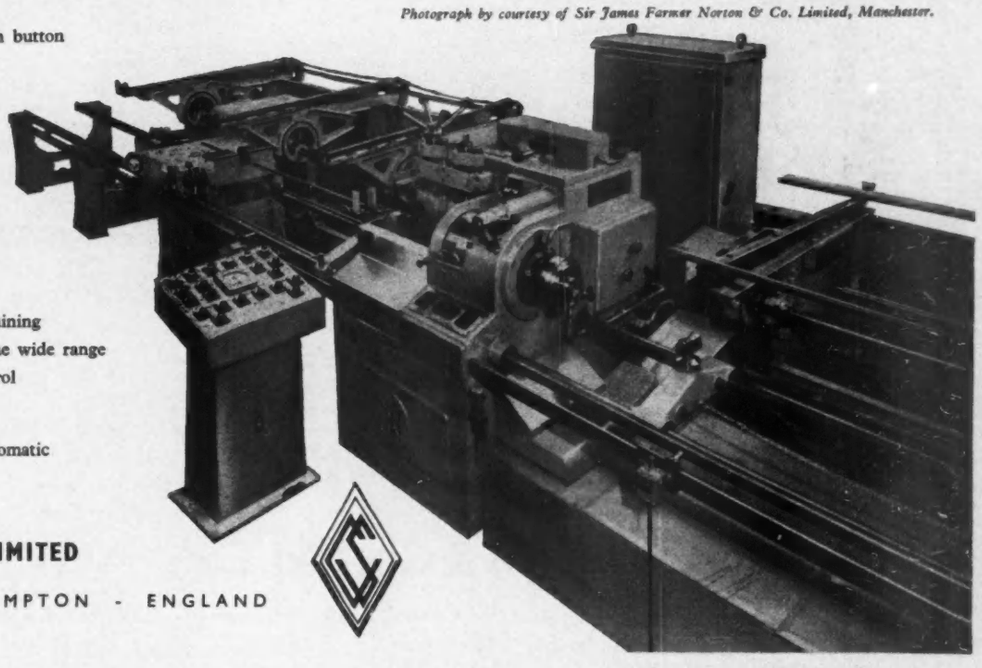

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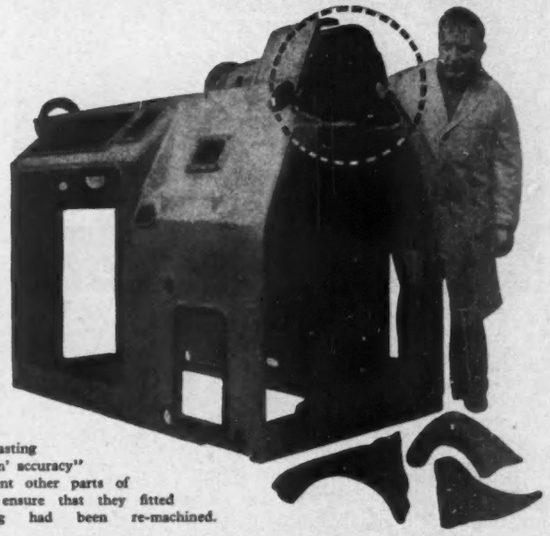

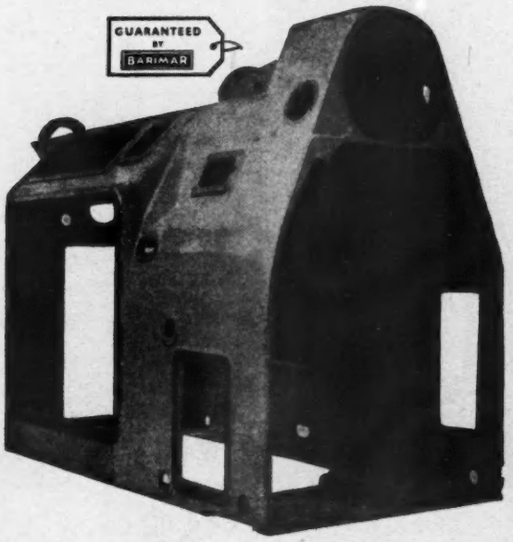

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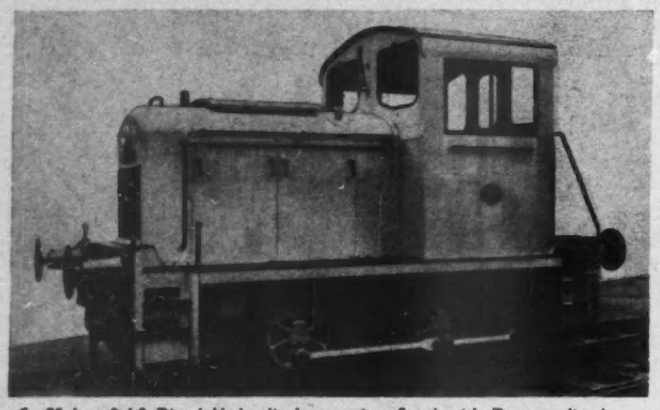

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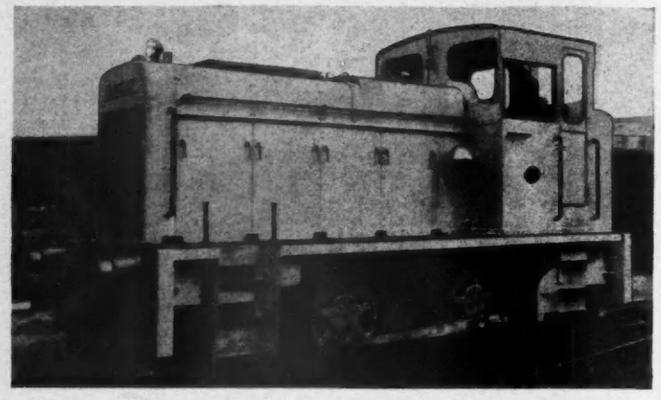

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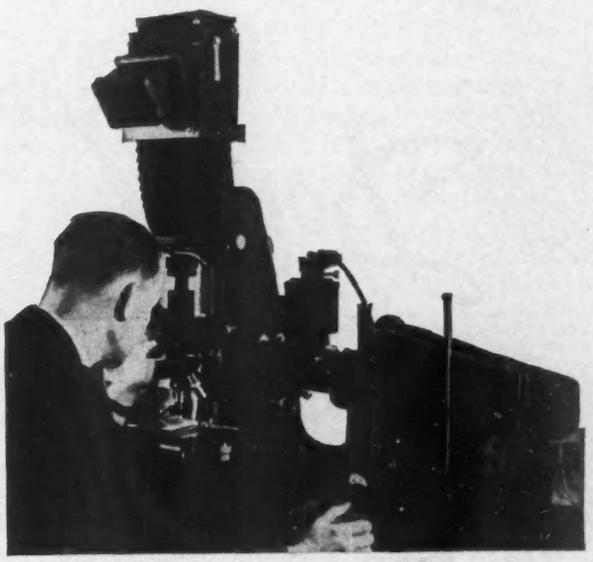

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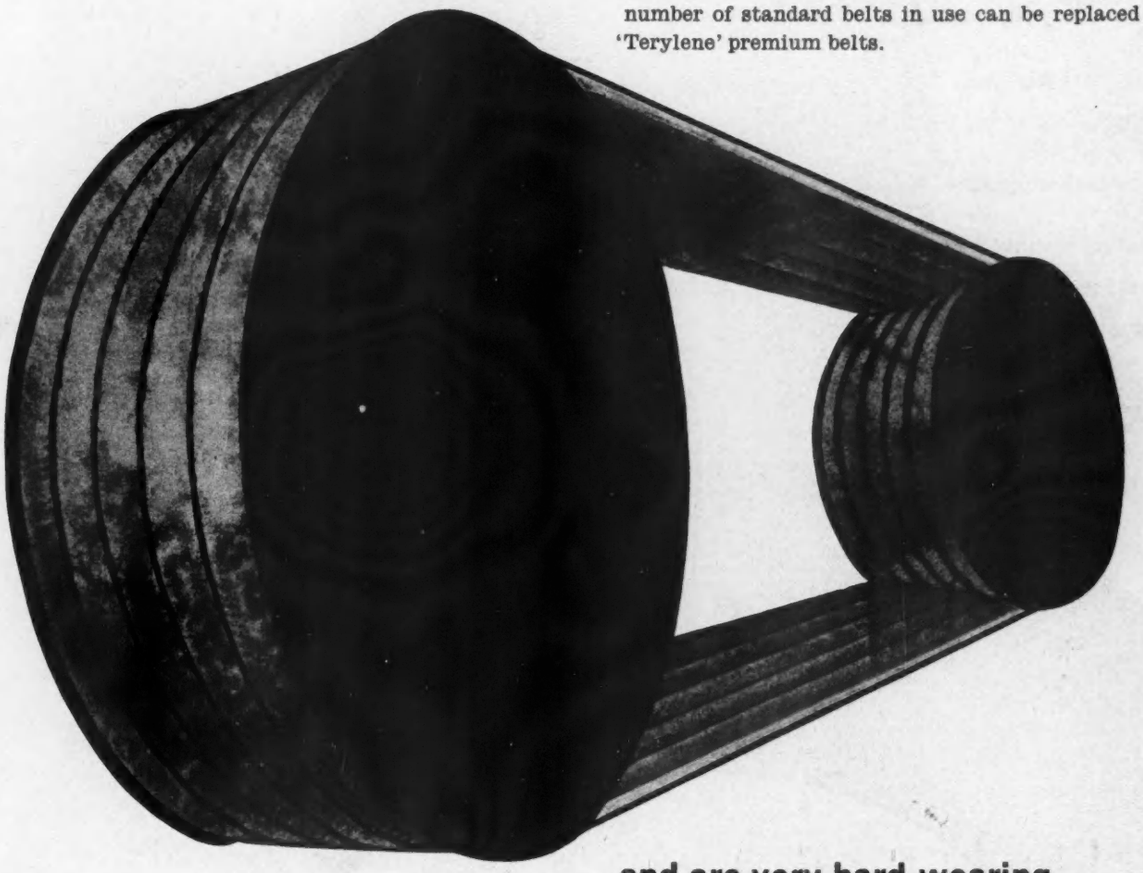

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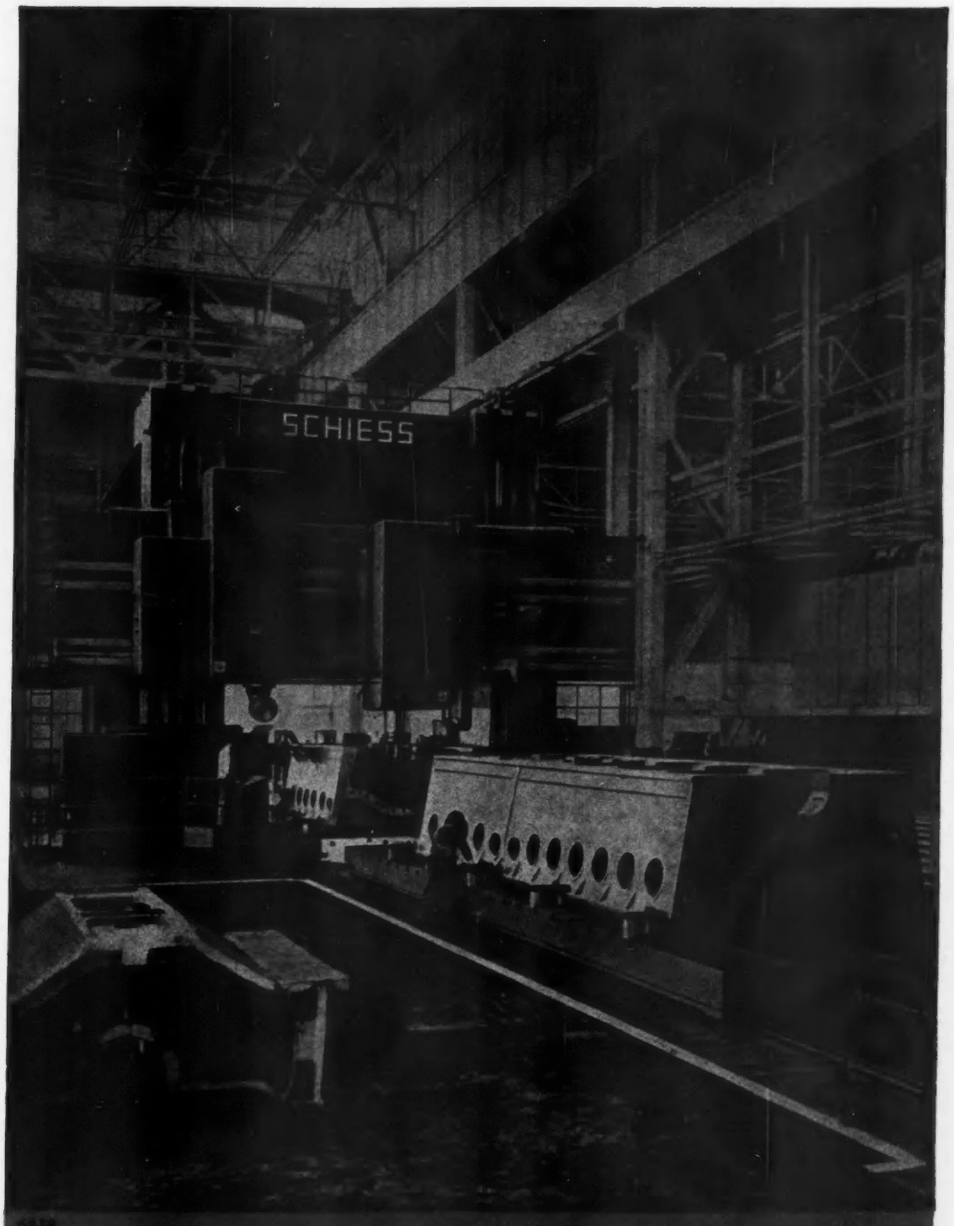

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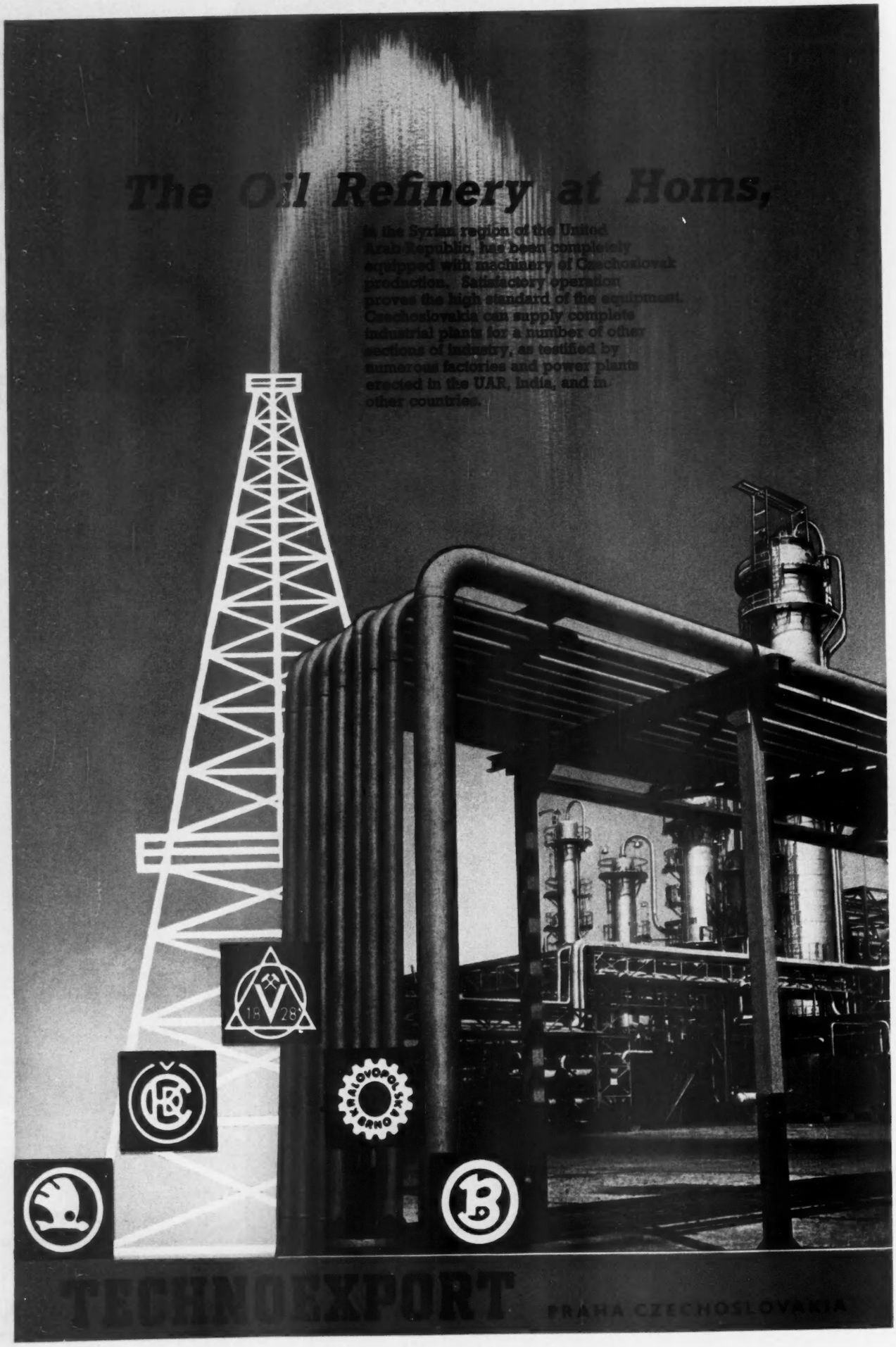
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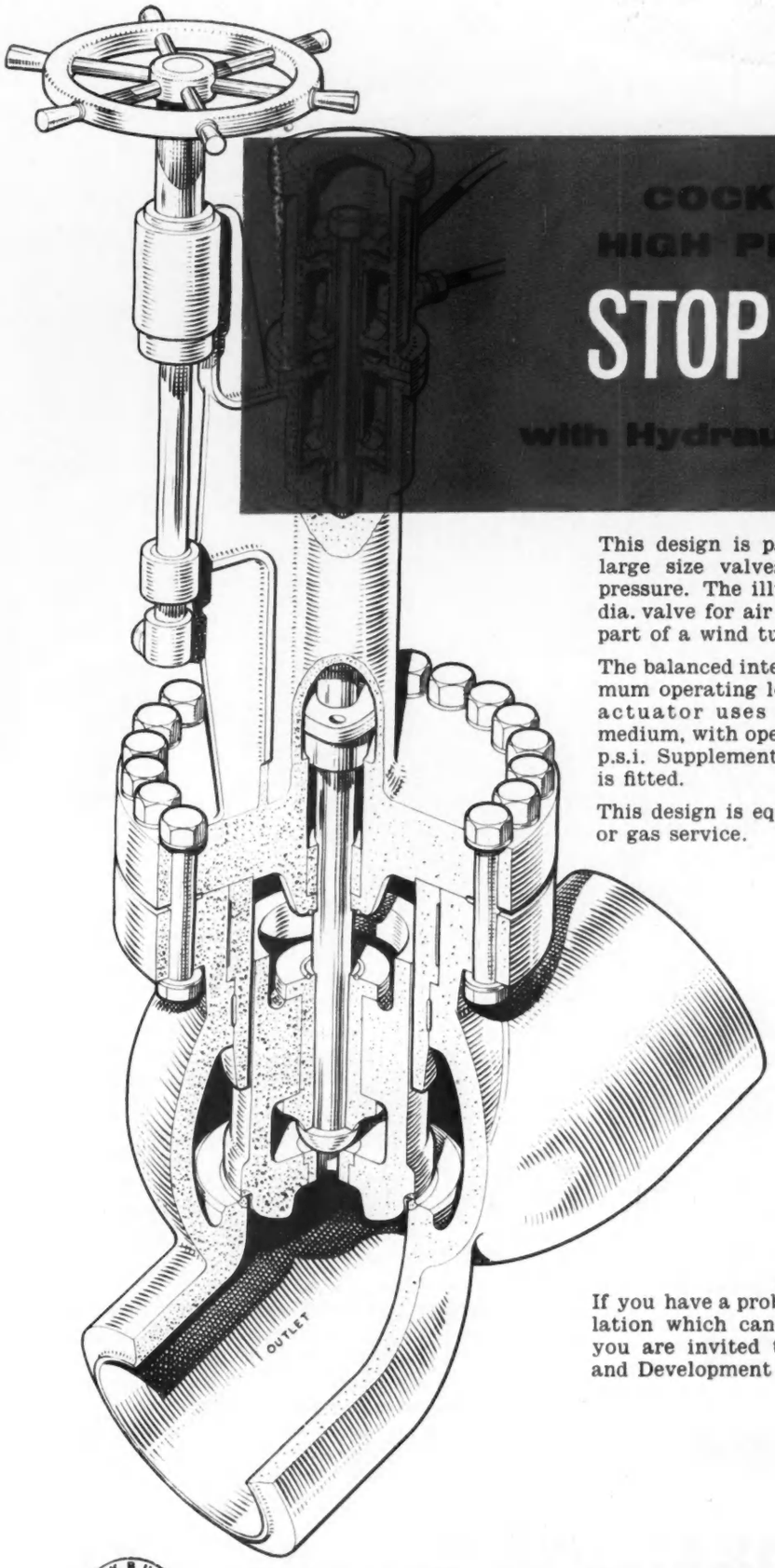

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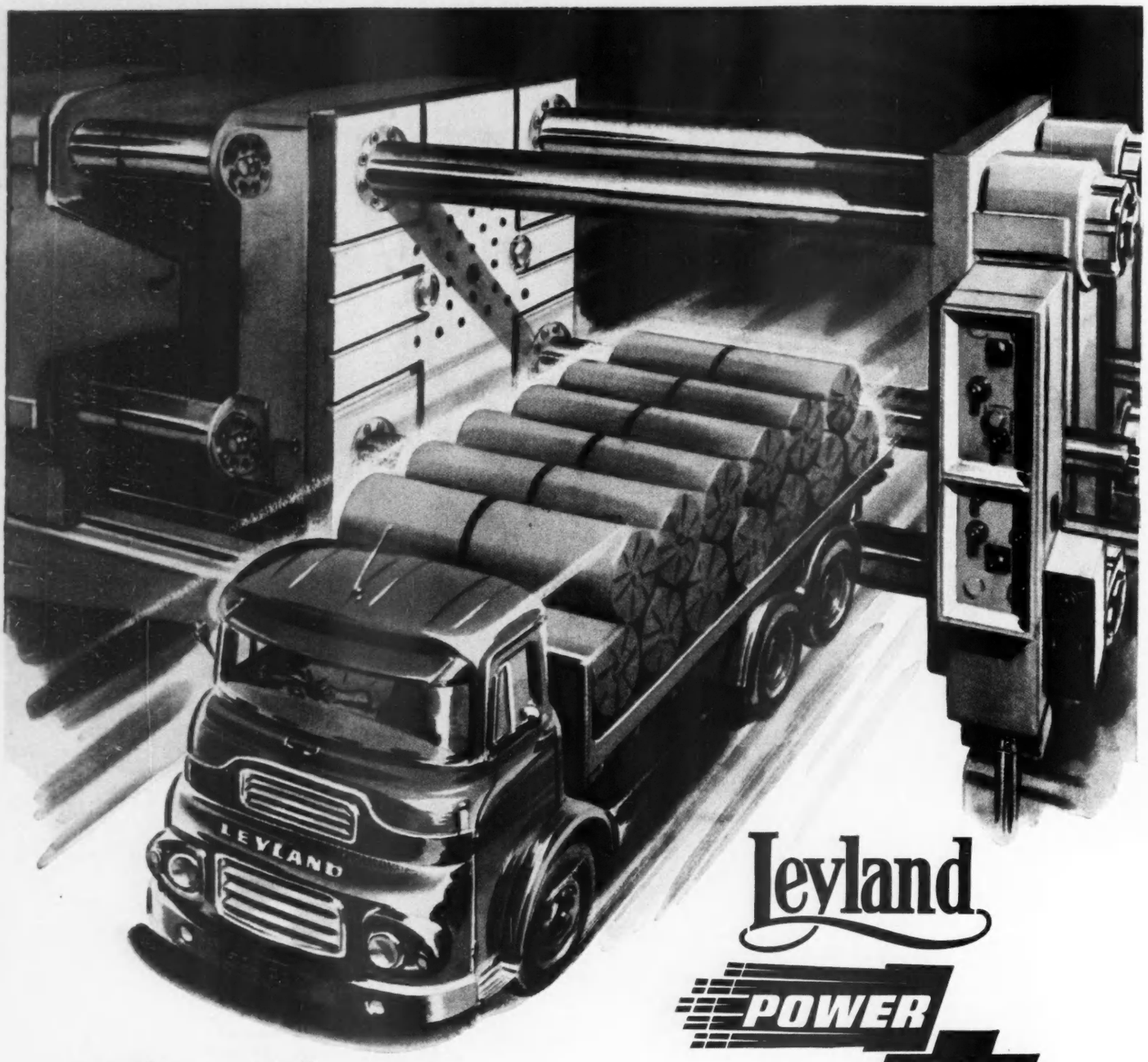

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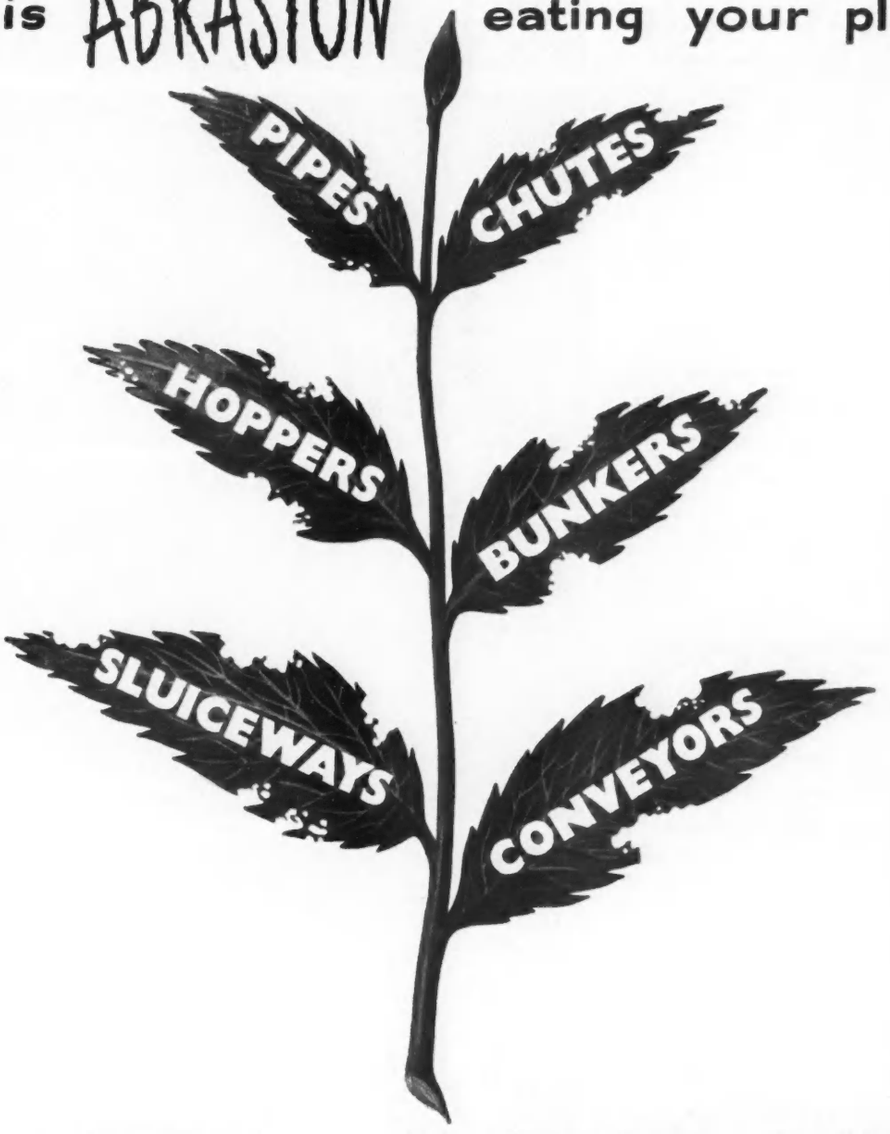

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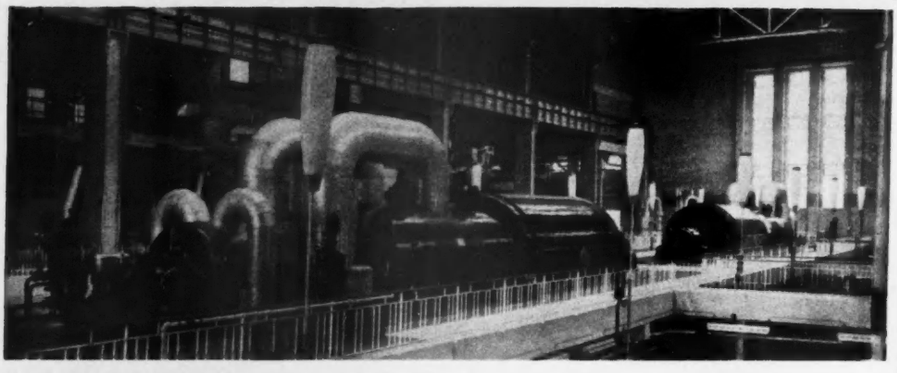
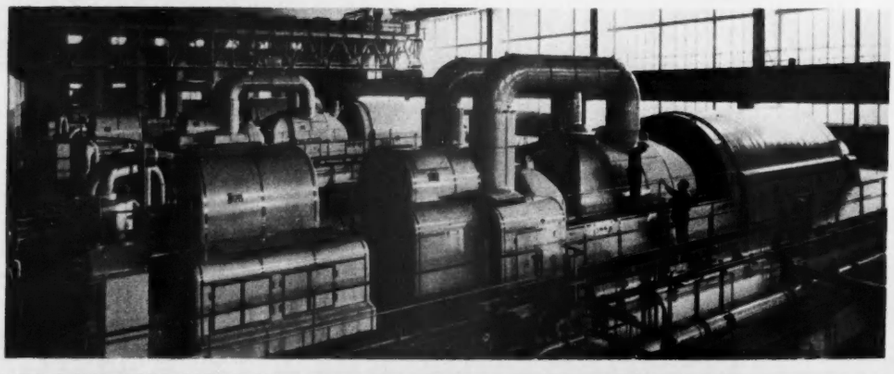
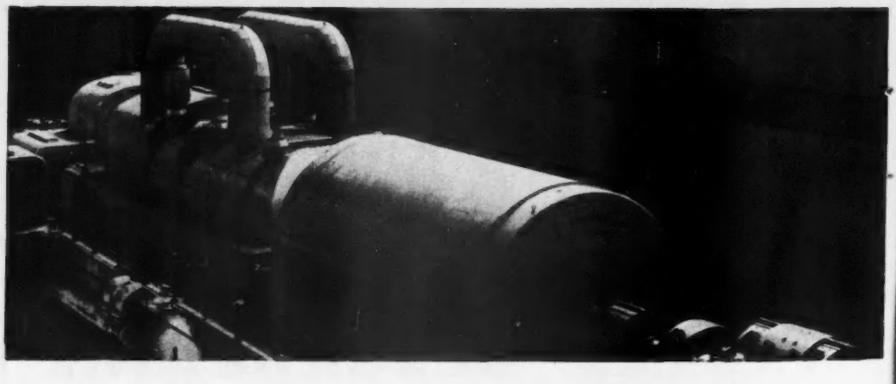
One of three PARSONS 120 MW turbo-generators at Kincardine power station, Scotland



Two PARSONS 60 MW turbo-generators at Little Barford power station, England



Three PARSONS 100 MW turbo-generators at Ferrybridge power station, England



One of four PARSONS 120 MW turbo-generators at Drakelow power station, England

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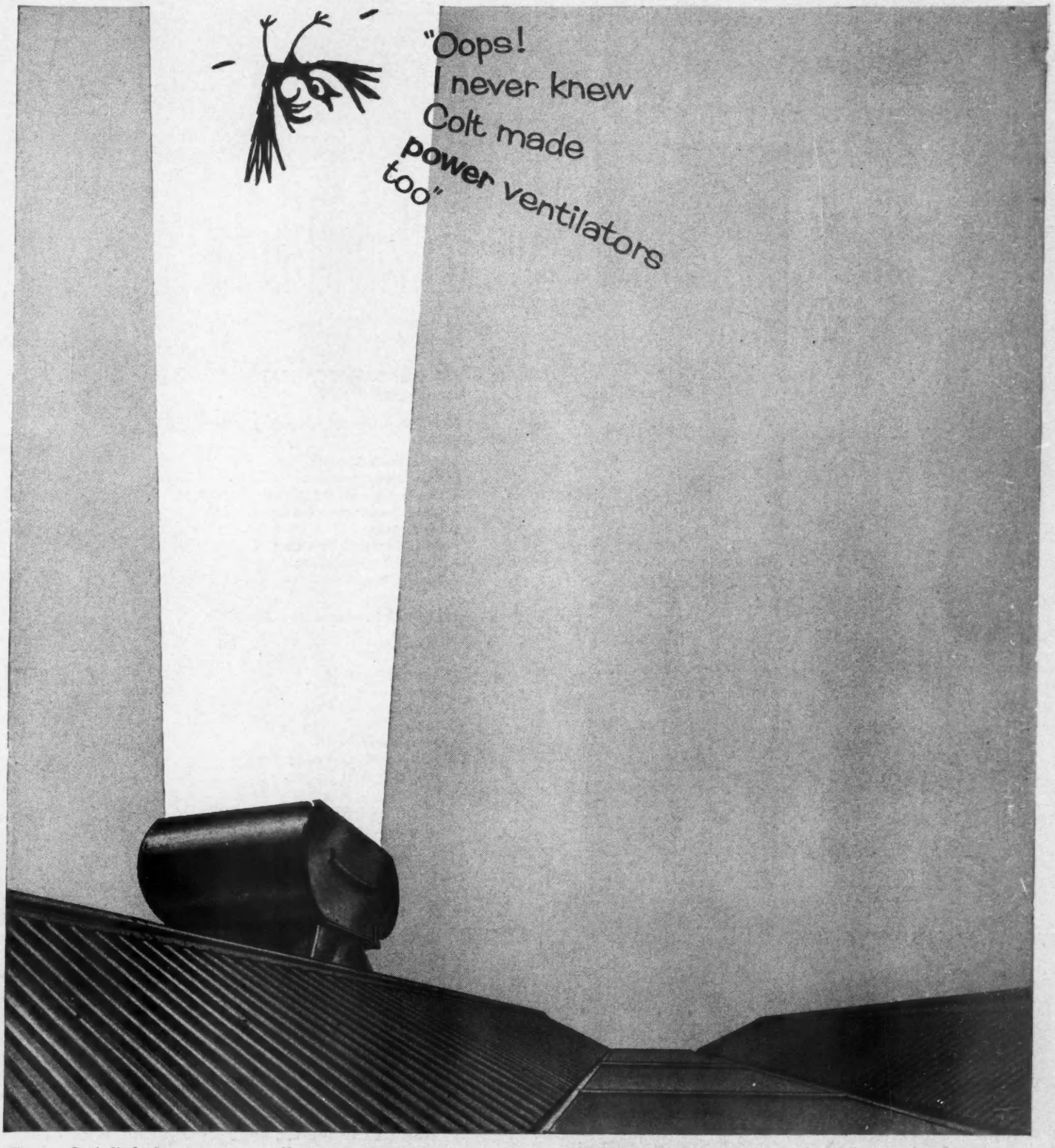

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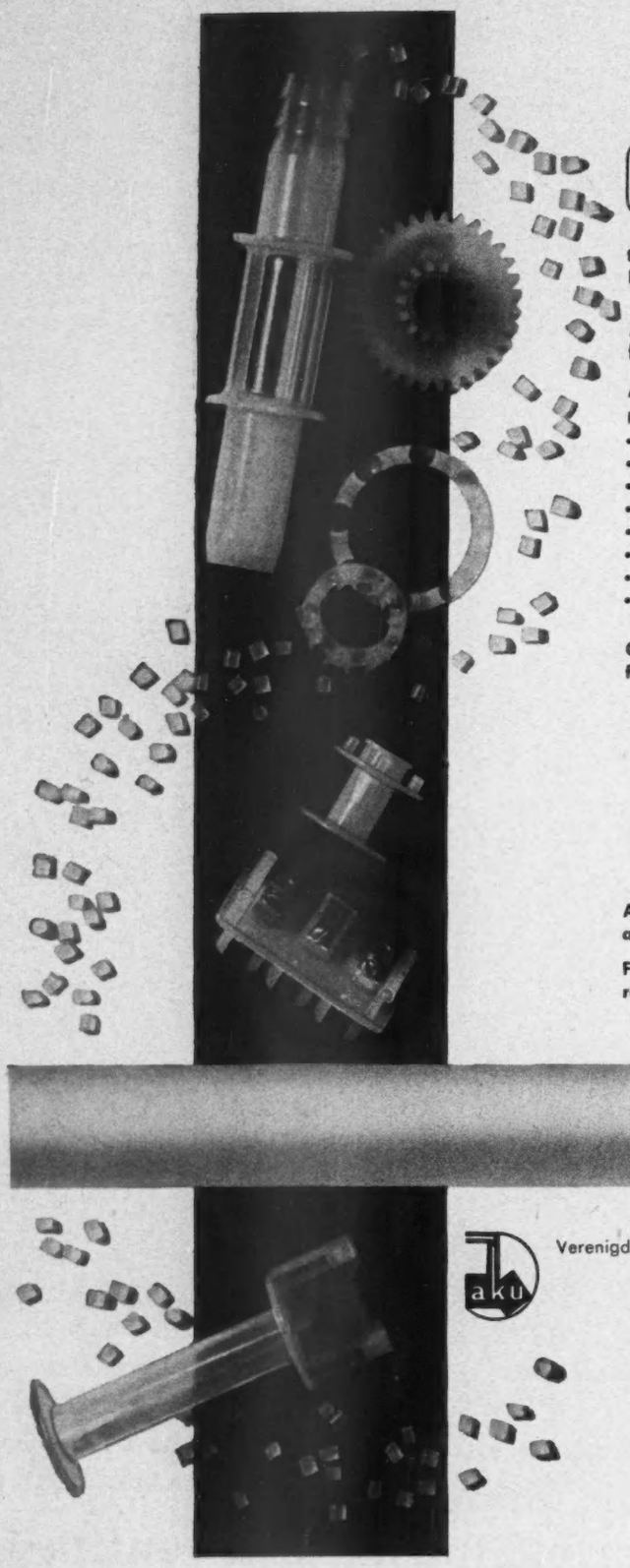

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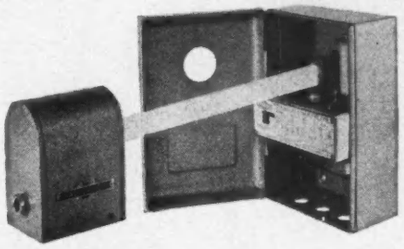

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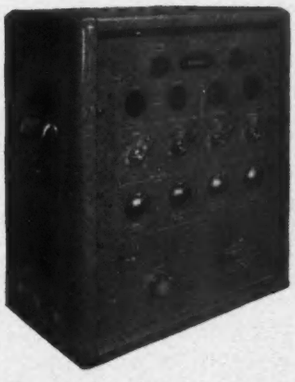

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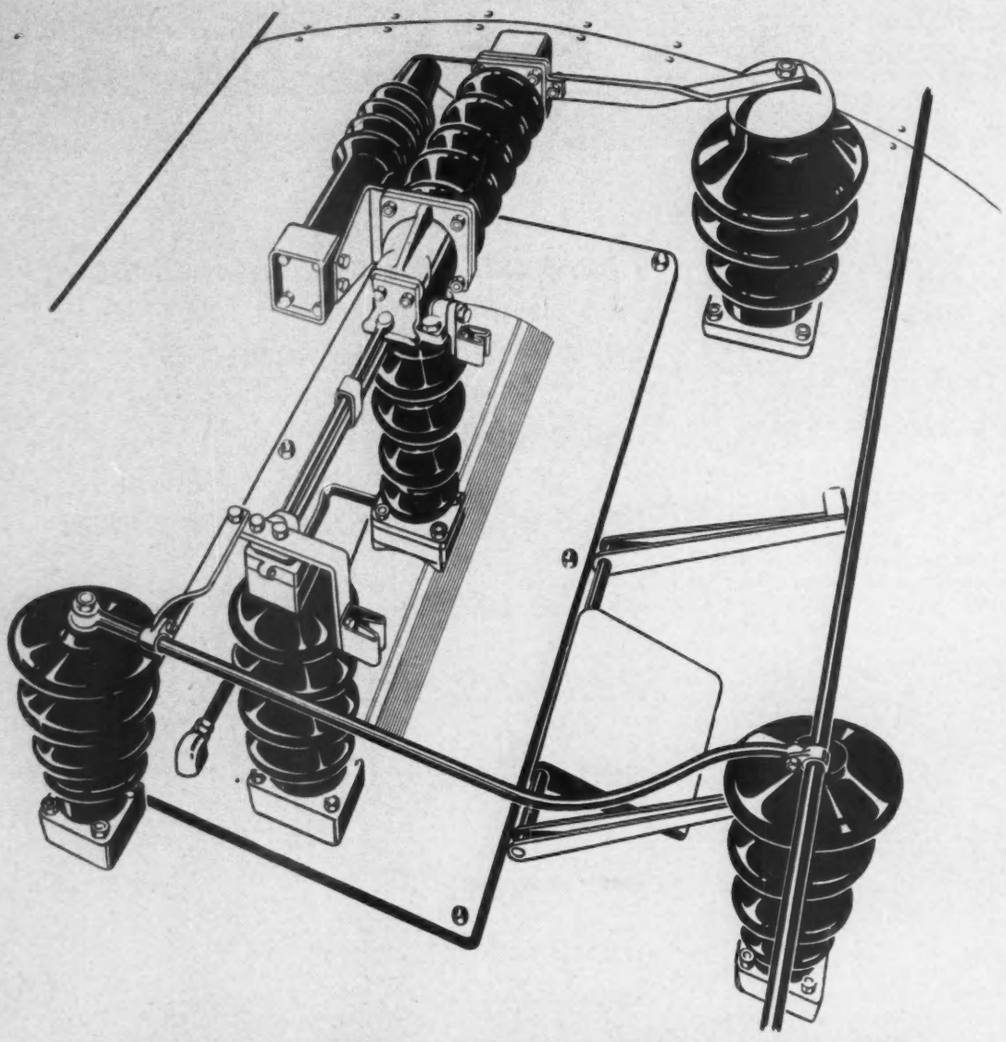

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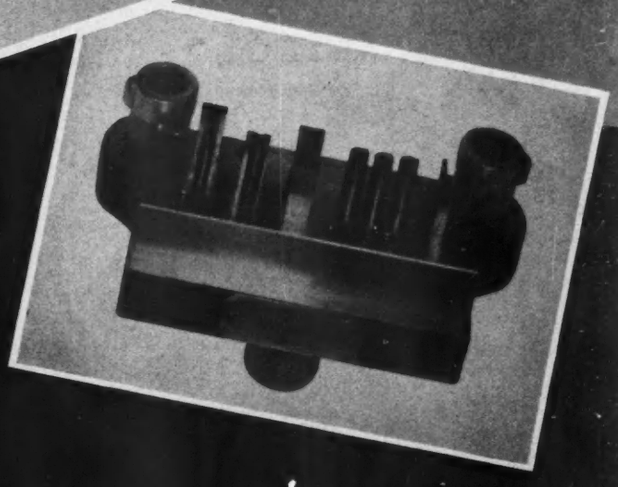

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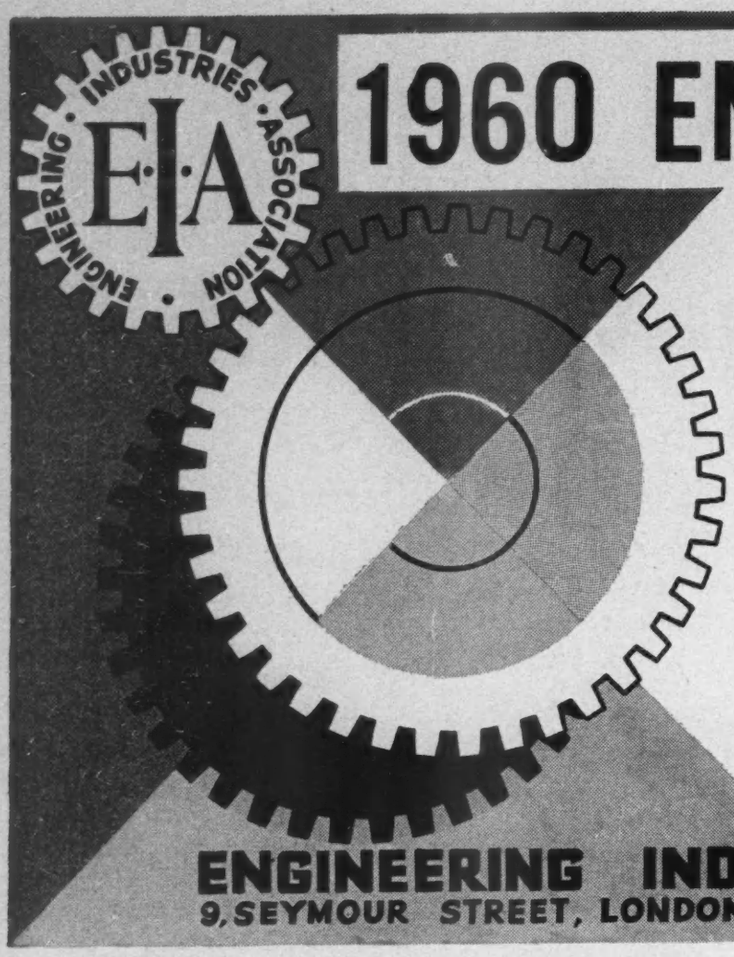

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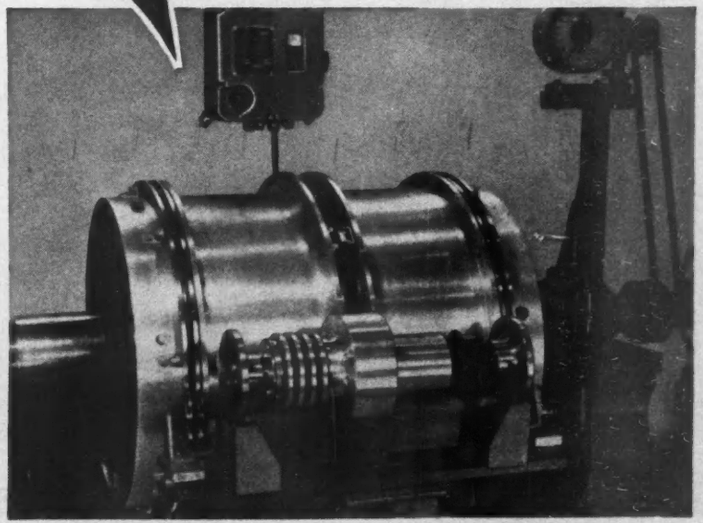

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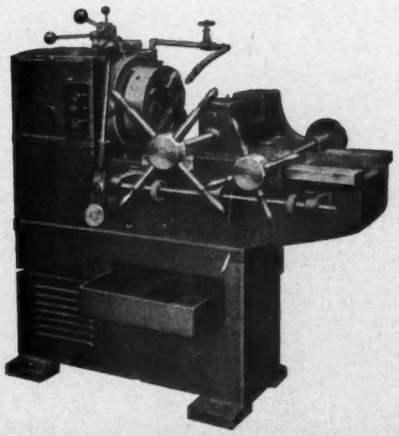

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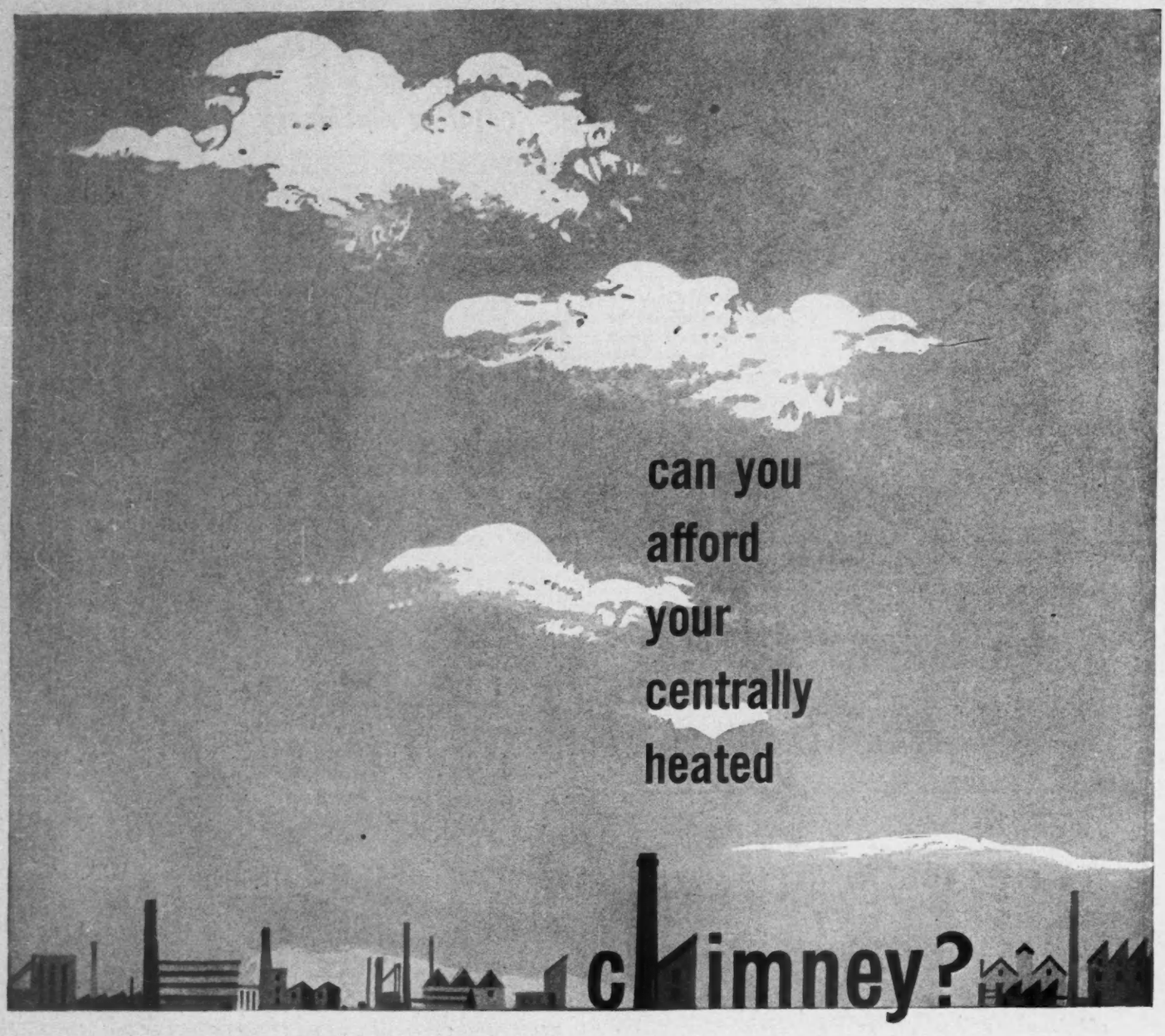

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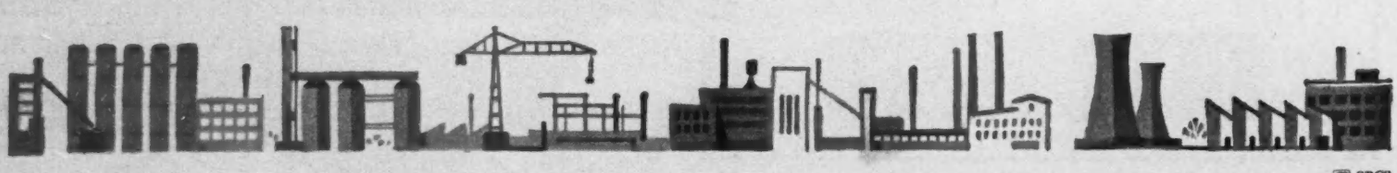

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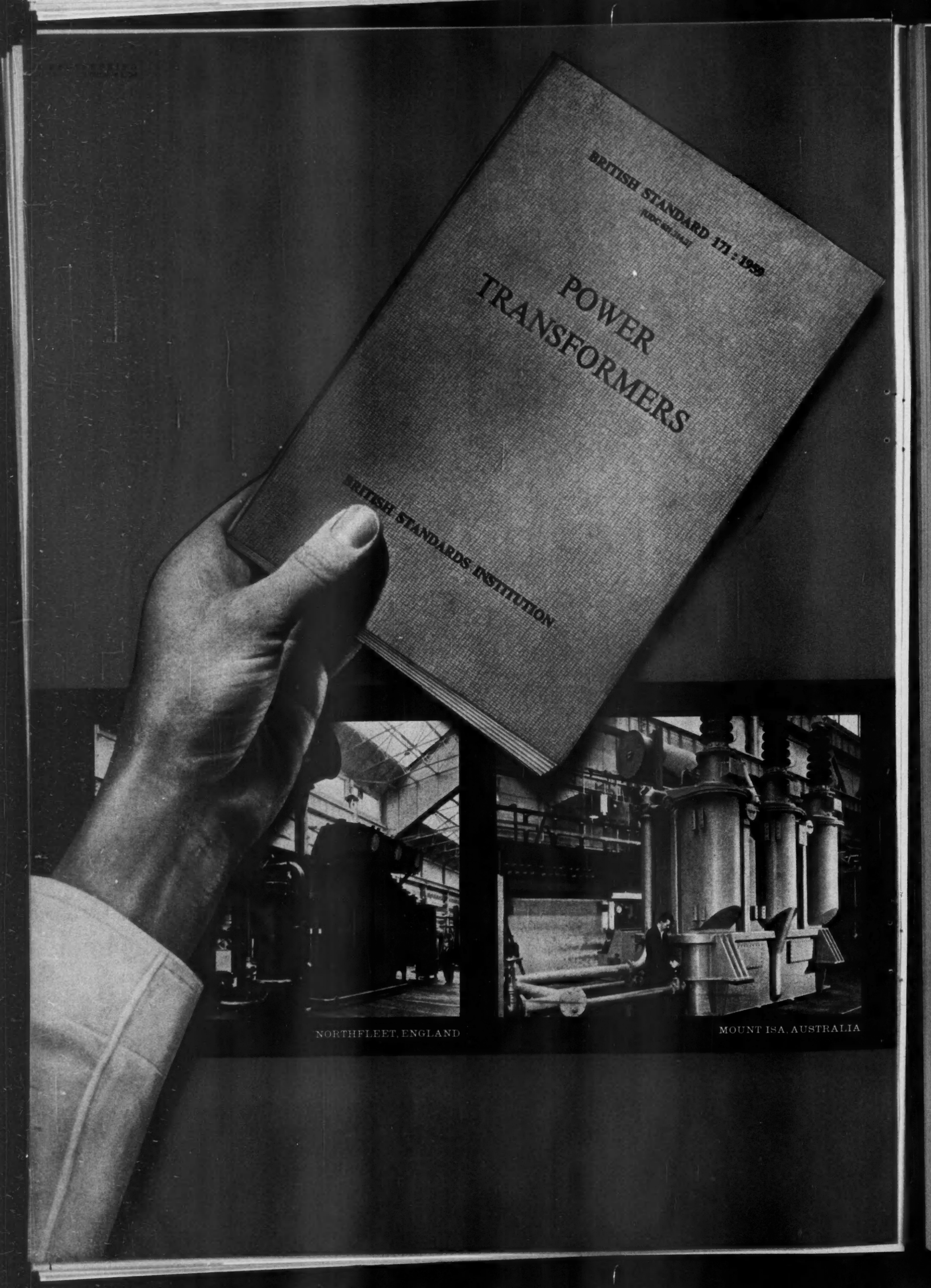
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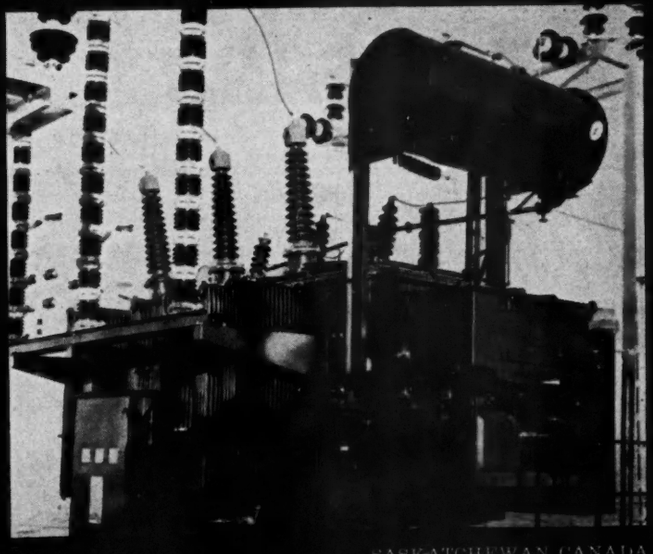

SASKATCHEWAN CANADA

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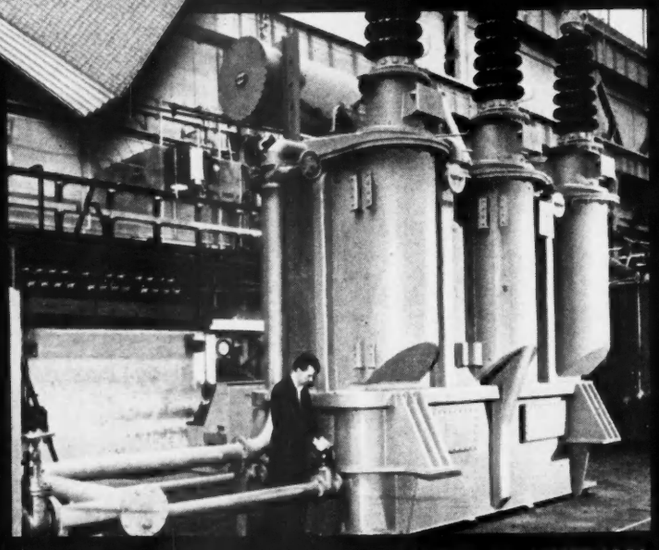

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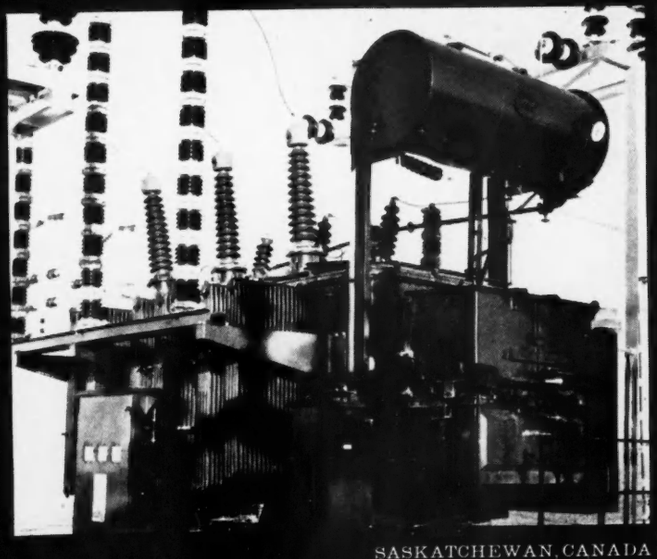

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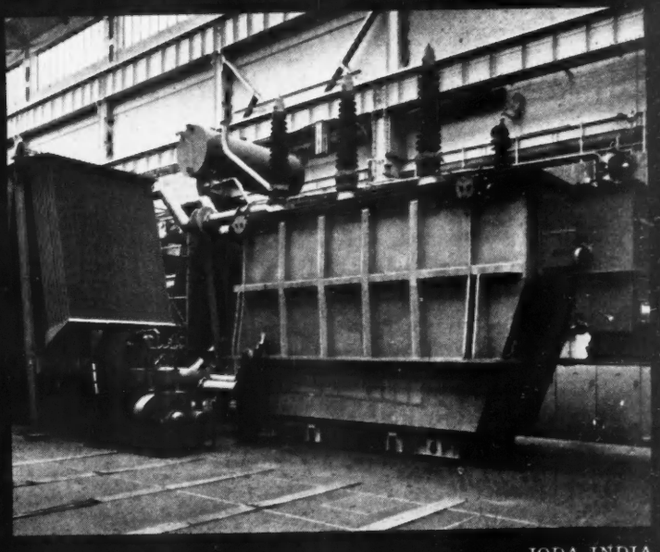

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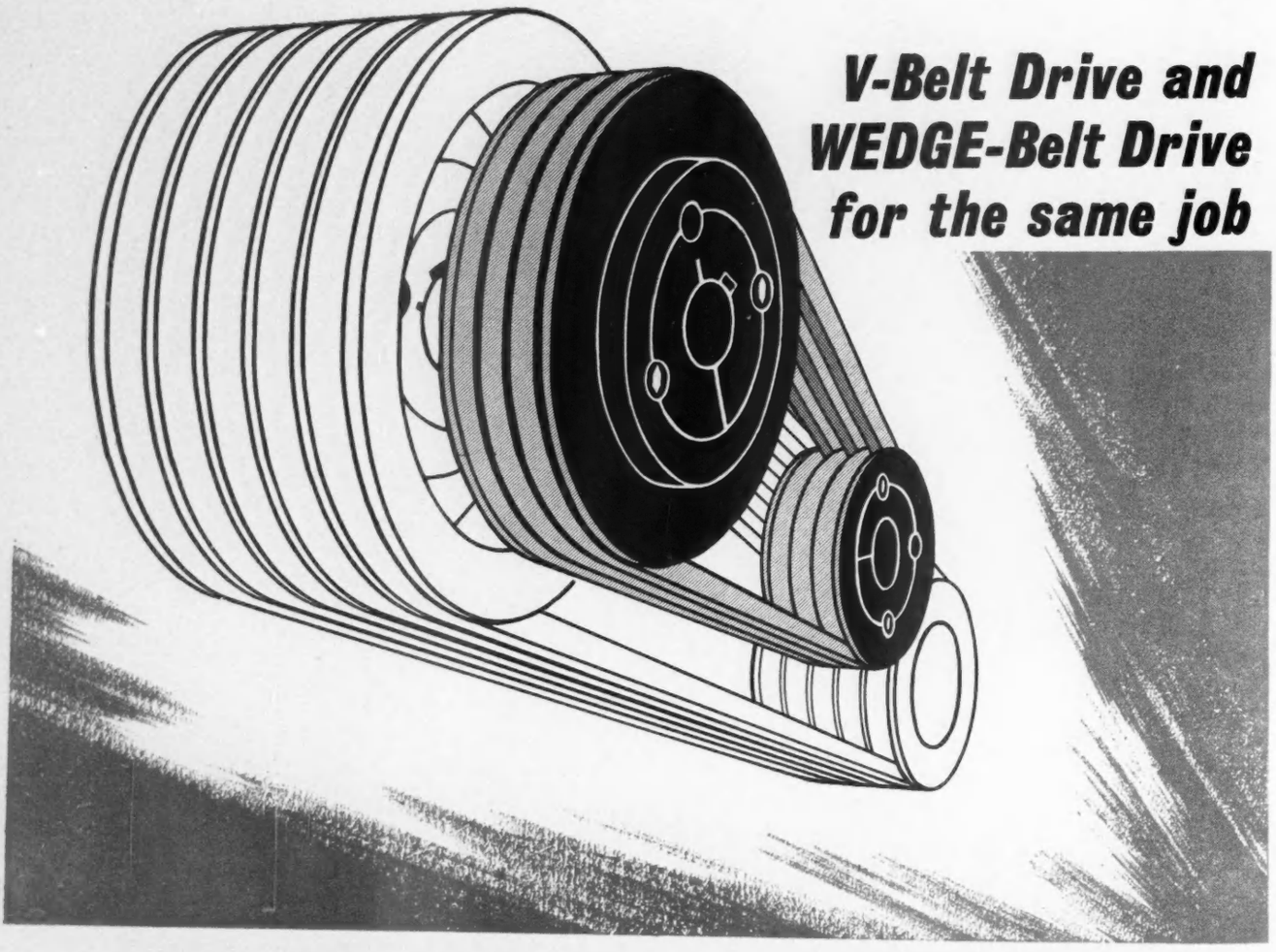

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WEDGE-BELT DRIVES

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SLIMMER, LIGHTER, SHORTER, CHEAPER

- Width and weight now reduced by a half, and cost by at least a fifth, without loss of strength or durability.
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5 H.P.	V-Belt	$3\frac{3}{4}$	$6\frac{3}{8}$	$3\frac{1}{4}$	5—A29	7·5	£6 · 8 · 7	16·7
	Wedge-Belt	3·15	5·60	$1\frac{1}{2}$	3 Alpha 280	7·1	£5 · 3 · 8	10·6
	SAVING	**16%**	**12%**	**54%**	—	**5%**	**19%**	**36%**
25 H.P.	V-Belt	$6\frac{1}{2}$	$12\frac{1}{2}$	$5\frac{7}{32}$	6—B65	18·7	£17 · 0 · 7	66·8
	Wedge-Belt	5·3	10·6	$2\frac{23}{32}$	6 Alpha 560	15·3	£11 · 11 · 6	36·2
	SAVING	**18%**	**15%**	**48%**	—	**18%**	**32%**	**45%**
50 H.P.	V-Belt	$8\frac{3}{4}$	$24\frac{3}{4}$	$6\frac{13}{16}$	6—C112	30·5	£45 · 0 · 1	258
	Wedge-Belt	7·1	21·2	$3\frac{3}{4}$	5 Beta 1000	26·9	£32 · 19 · 9	138
	SAVING	**19%**	**14%**	**45%**	—	**12%**	**26%**	**46%**
100 H.P.	V-Belt	$10\frac{3}{4}$	$42\frac{3}{4}$	$8\frac{15}{16}$	8—C180	47·2	£86 · 2 · 4	530
	Wedge-Belt	9·0	37·5	$4\frac{7}{16}$	6 Beta 1600	41·1	£63 · 15 · 2	340
	SAVING	**16%**	**12%**	**50%**	—	**13%**	**26%**	**35%**

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Operations . . .

no spares, no maintenance

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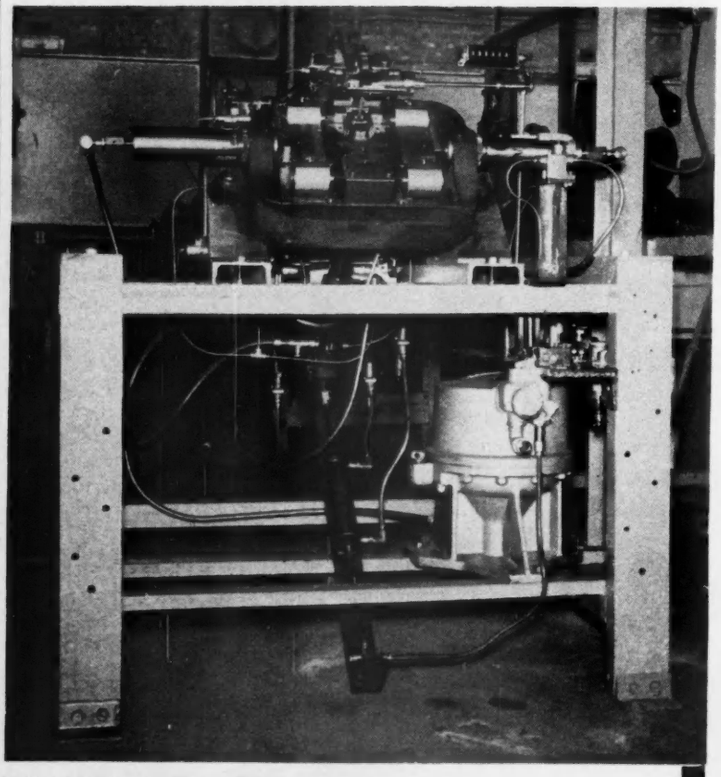
Each machine has performed 5¼ MILLION OPERATIONS *WITHOUT* any SPARES or MAINTENANCE. A third machine is now being installed.

You will be well advised if you discuss your compressed air problems with a "BROOMWADE" works-trained technical representative. Meanwhile, may we send you a copy of our leaflet giving full details of "BROOMWADE" Squeeze Riveting Equipment?

Two views of the "BROOMWADE" Hydro-Pneumatic equipment installed by Messrs. S. Smith & Sons (England) Ltd., by whose permission these pictures are published



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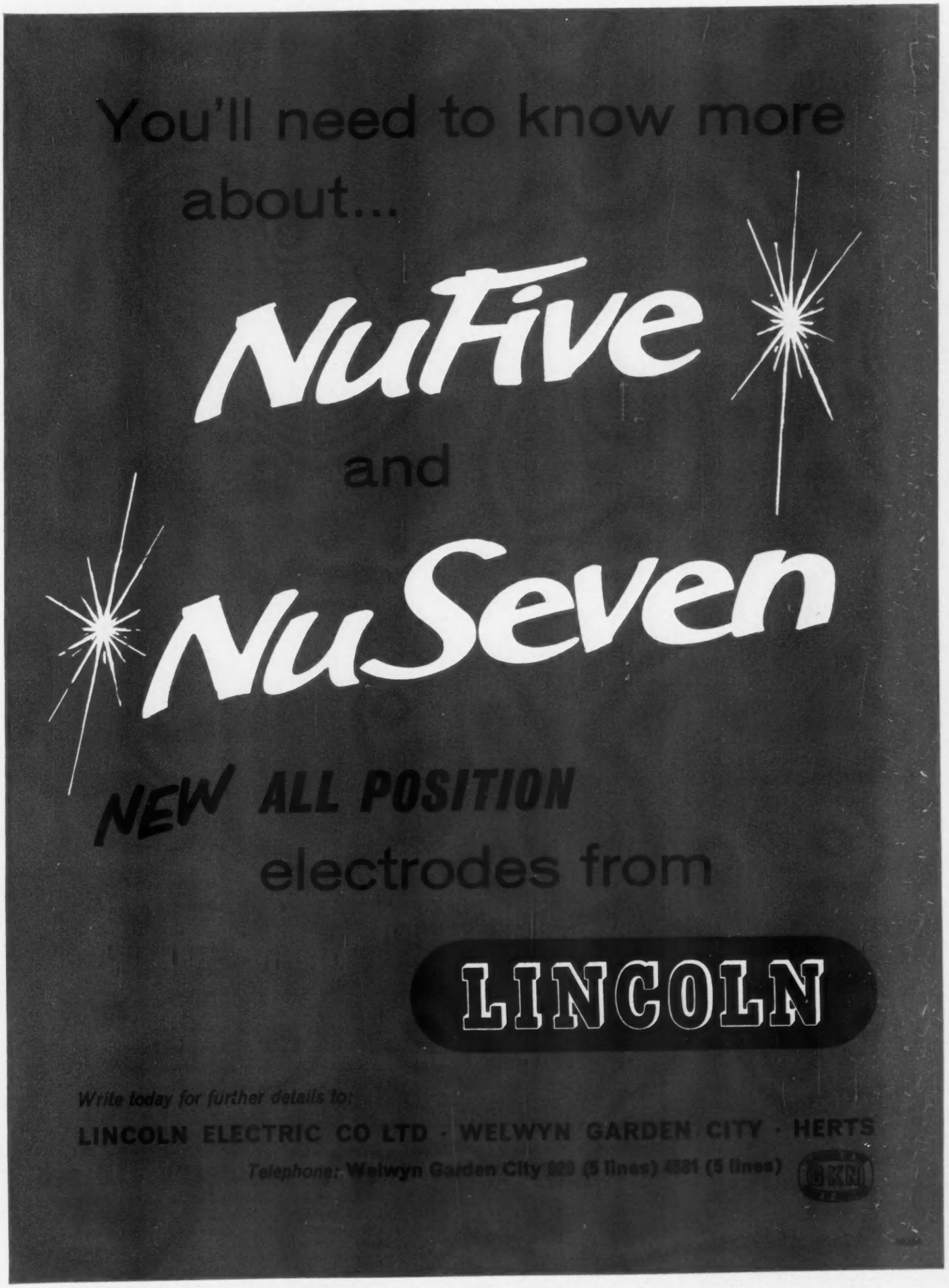
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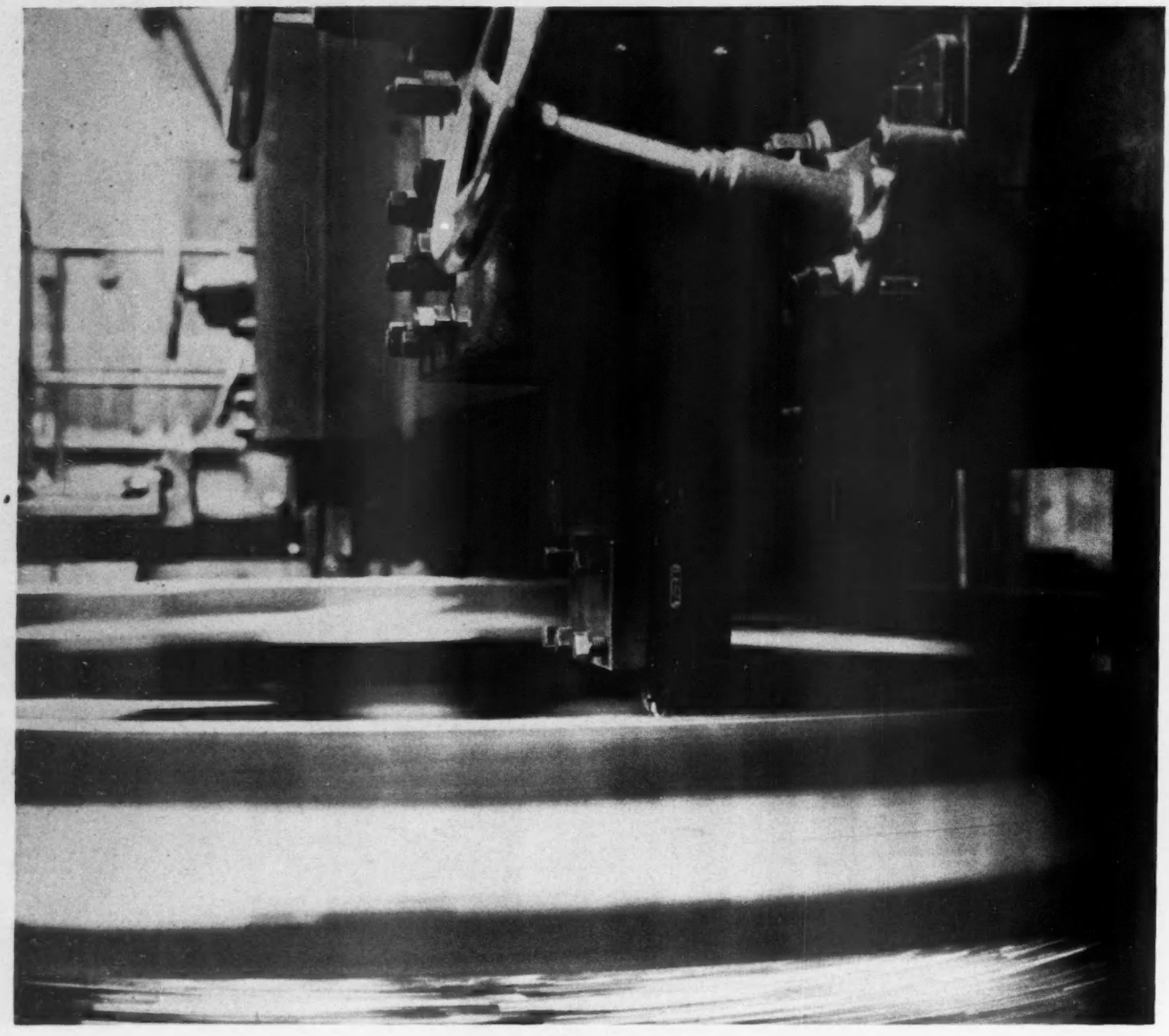

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the big stuff is nothing new for Crofts. They've been doing it for years. Really big stuff, too. Spur and helical gears up to 185in. diameter, 37in. face width, 5in. CP—that's the way Crofts talk.
Here's a spur in Crofts fitting shop being turned into a powerful help to somebody, and it could be you. When it comes to big stuff (casting, machining and cutting), call Crofts—they've been doing it for years.

* *Customer's blanks can be cut and gears manufactured to special order, but remember Crofts STOCK RANGE includes Spur and Mitre Gear Drives up to 70 h.p. and Bevel Gears up to 44 h.p. We also produce Internal Gears, Racks and Pinions, Worms and Wheels, Spiral Bevels and Spiral Mitres. And Crofts can handle Steel Castings up to 8 tons!*
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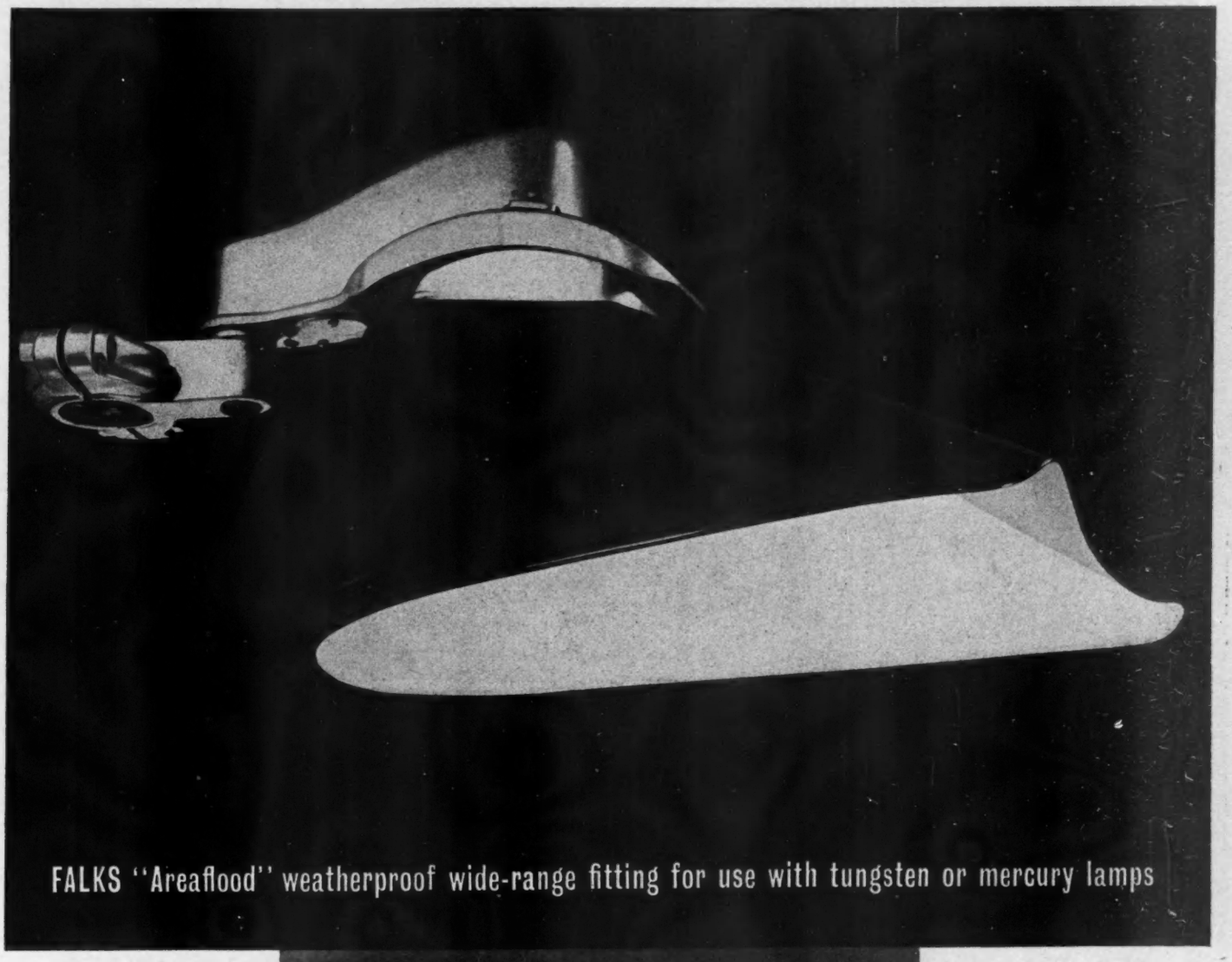
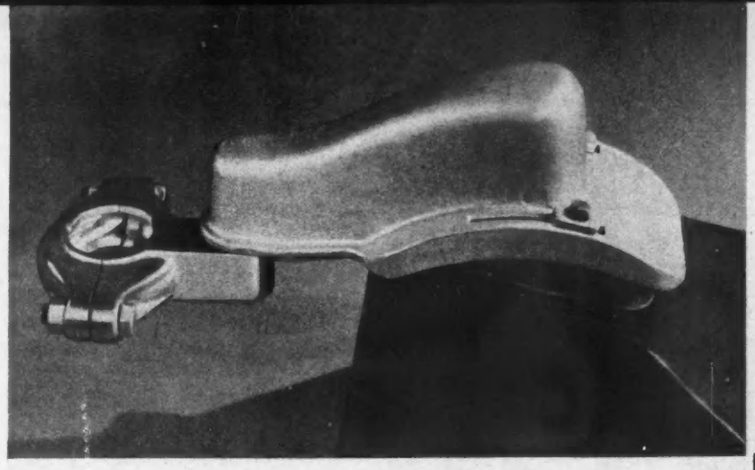


FALKS "Areaflood" weatherproof wide-range fitting for use with tungsten or mercury lamps

FALKS "Areaflood" throws the light exactly where wanted



FOR POLE OR WALL MOUNTING

The "Areaflood" has adjustable features permitting movement in two directions, allowing the downward light to be directed wherever desired. The reduced price makes it a real value-for-money fitting for area lighting including car parks, garages, sports grounds and swimming pools.

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AP 117

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The Alston Foundry Company Limited, of Cumberland, say: ***"The *bridge is perpetually exposed to the elements, the action of which has had absolutely no effect whatever on the installation . . . there have been no appreciable signs of wear and it has never been necessary to carry out any form of maintenance to the bridge walkway in the period under review."***

ALAFLOR

*They were referring to a bridge which, since its installation, has carried tens of thousands of people, in heavy industrial footwear, in the worst weather in England. An ALAFLOR installation, of course! The illustration shows the ALAFLOR bridge after 6 years.

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The visual indicator illustrated is fitted in one of two cranes and provides a continuous indication of the relative position of the two cranes.
The System may be adapted to protect other structures with slewing or elevating jibs, rotary or translational motion, providing only that these follow fixed paths, e.g. rail tracks.

TYPE 215 GANTRY CRANE WARNING SYSTEM
A new, simple, easily installed, yet foolproof system which is based on well tried components.
The system employs photo-electric cells and light projectors, but by a unique principle, combines simplicity with greatly improved ability to work in bad conditions.
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Full information on the crane collision warning systems is available from:

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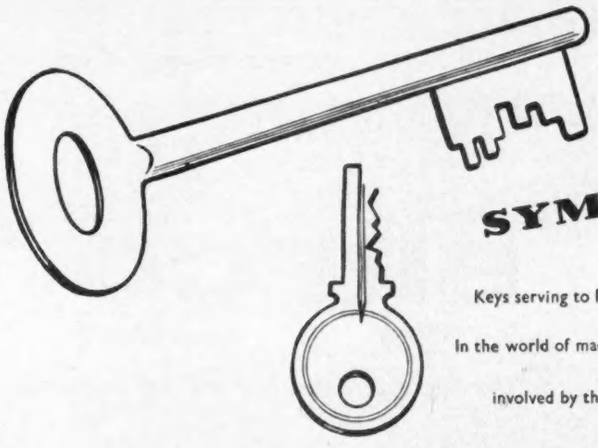

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Keys serving to lock out, as well as in, can be regarded also as symbols of freedom from things unwanted.

In the world of machinery, freedom from breakdown, from inaccurate working, and from the extra expense involved by the presence of these two undesirables, gives the best possible security for efficient production.

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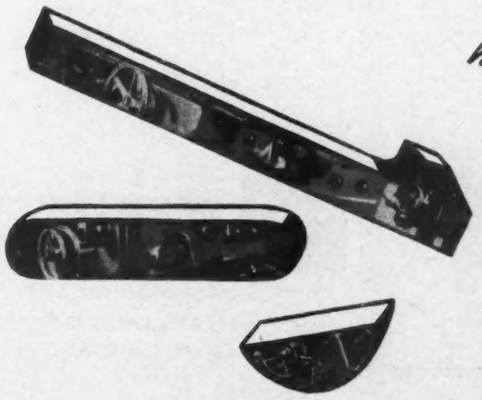

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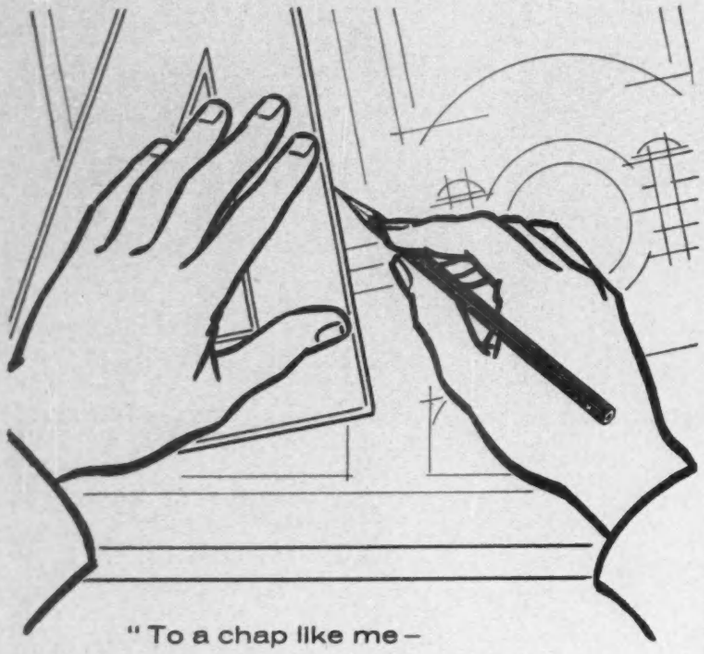

"To a chap like me –
and I'm proud of my work – my pencil's my living.
The pencils I use have to stand up to fast hard work, their grading's got to be absolutely spot on – not almost or nearly but bang on the dot every time.
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"What pencils do I use?"

"Venus drawing pencils of course, the ones with the crackle finish! – how else do you think I keep my high standard?"

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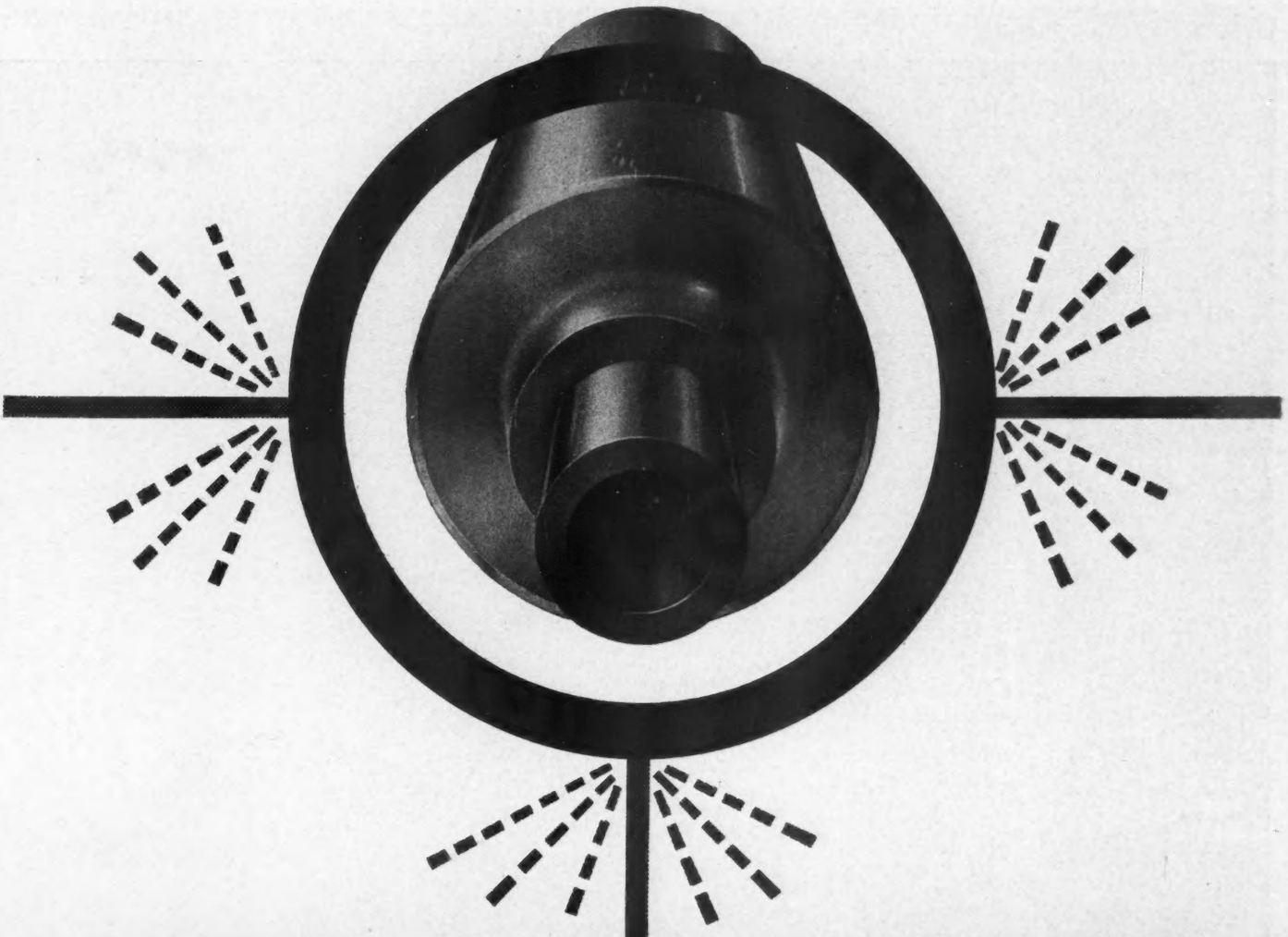
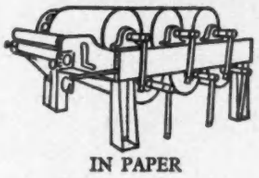


ROLL CLADDING for permanent protection

The many advantages of the roll cladding have made it immediately acceptable in many industries:



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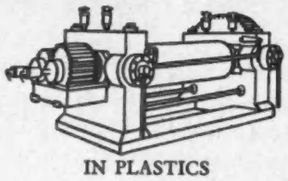

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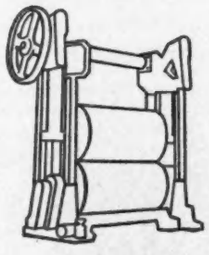

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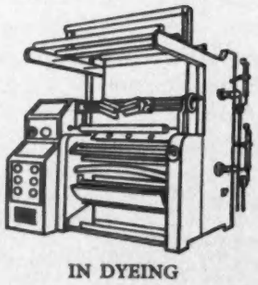

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Rosedowns supply complete clad rolls or alternatively, the process can be applied to customers' own rolls, shafts etc. Work is accepted from 4 to 42 inches in diameter, in length up to 23 feet 6 inches, machined, ground and polished to precision limits.

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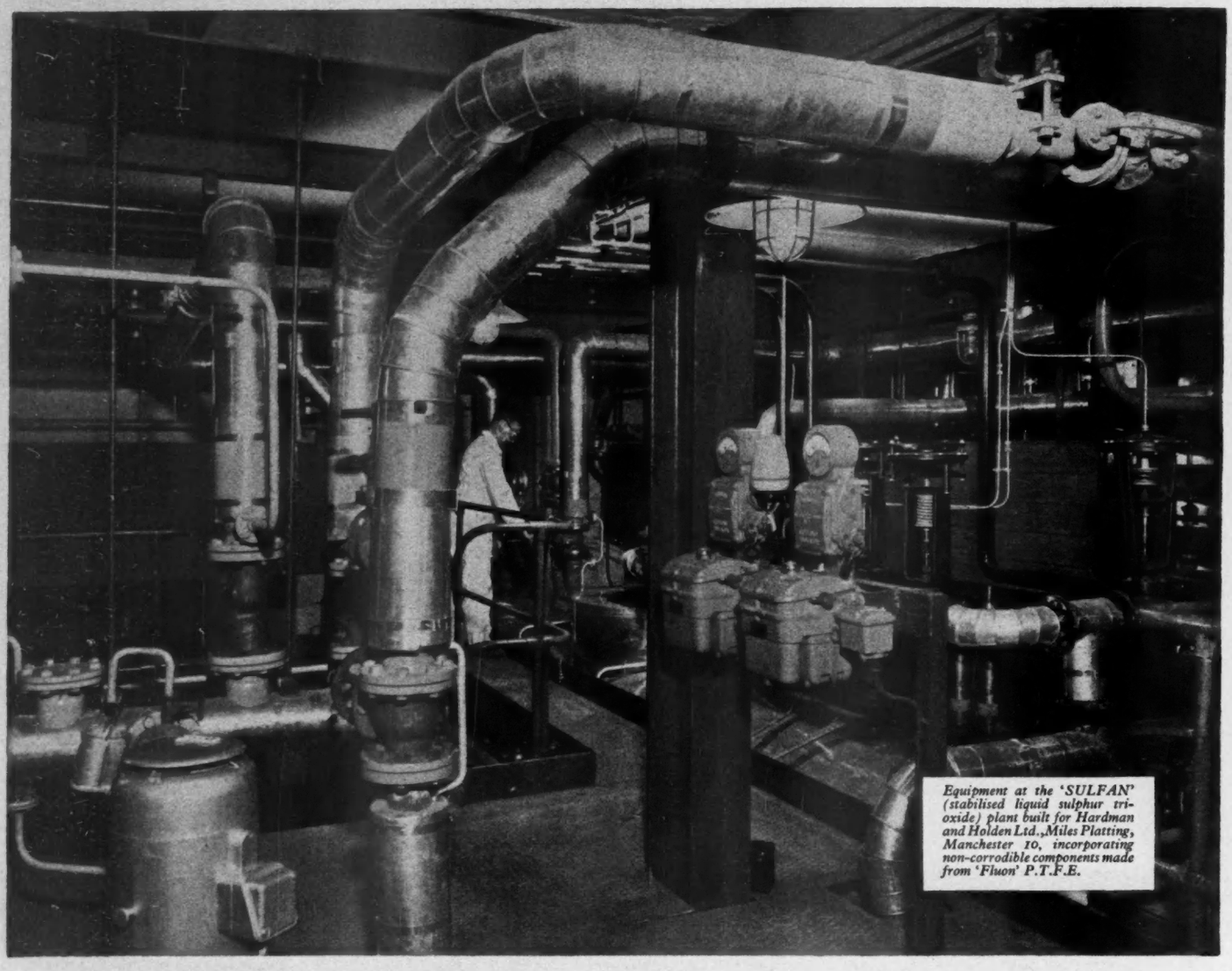
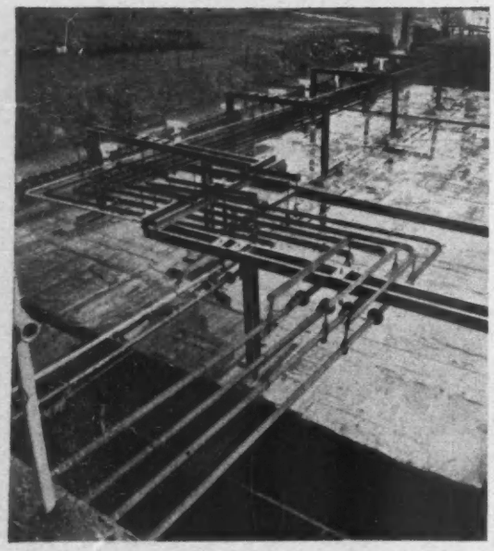
'FLUON' INCREASES PRODUCTION EFFICIENCY IN INDUSTRY



Equipment at the 'SULFAN' (stabilised liquid sulphur trioxide) plant built for Hardman and Holden Ltd., Miles Platting, Manchester 10, incorporating non-corrodible components made from 'Fluon' P.T.F.E.

'Fluon' specified to simplify handling of highly corrosive 'Sulfan' at new plant



External view of the transfer system of the 'SULFAN' plant at Hardman & Holden Ltd.

When Hardman & Holden Ltd. had their new plant built to produce 'SULFAN' in this country, one of the most important specifications in the design was the use of 'Fluon' P.T.F.E. for all jointing, packing, valve discs, control valve diaphragms and flexible pipes and connections.* Tests of alternative materials and later production experience showed that without the use of 'Fluon' considerable difficulties would have been encountered.

'Fluon' is an I.C.I. plastic material which is immune to virtually all forms of chemical attack. It has a working temperature from +250°C. down to at least liquid nitrogen temperatures and the best dielectric properties and lowest coefficients of friction of any solid. It is also both tough and flexible.

** Components for the 'Sulfan' plant were made from solid 'Fluon' p.t.f.e. by Crane packing Ltd.; Henry Crossley (Packings) Ltd.; Richard Klinger Ltd.; Oil Feed Engineering Co. Ltd.; James Walker & Co. Ltd.*

'FLUON'

'Fluon' is the registered trade mark for the polytetrafluoroethylene manufactured by I.C.I.

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. . . that's the beauty of it

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The illustration shows a Rectifier Control Grid, a Rectifier Anode, a Boat, a Bearing, two Gland Rings, a Piston Ring, a Tube and a Valve Anode—just a small selection of products showing the remarkable versatility of Morganite Carbon.

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- Cover compounded for long life and resistance to sun and weather.
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A Welder at work. An Adolf Morath picture by permission of Bradwell Nuclear Power Station and The Nuclear Power Group.

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ENGINEERING Impact

of Getting the Best From a Giant

THE English Electric Company has a special place in industry. For dash and flair, particularly for doing commercial battle against heavy odds in the United States, the company has won a high regard.

At a time when there appears to be more than enough capacity in heavy electrical equipment manufacture, it is important to ask why the directors of English Electric and of the General Electric Company believe it to be wise to move towards a merger through the setting up of a holding company.

The cost of research and development is very heavy for both groups. Some saving of money, and perhaps improvement of results, could flow from the elimination of duplication and from concentration upon certain projects.

What is certain is that whoever presides over the new company will be at the head of a concern producing a range of goods over which he cannot possibly have intimate understanding. From nuclear power stations to washing machines, from telecommunications equipment to aircraft engines, this is only a modest indication of the breadth of the proposed new group.

General Electric, in their last annual report, indicated that efforts were being made for a new form of organisation through the group. There is certainly a problem in groups of this size of seeing that the policy making executives are aware of what is being done, and what is happening, before it is too late to do more than attack the question of "doing better next year." There is a not altogether engaging air of fatalism in some of the big concerns' statements.

The new group will have very great size and power, and also immense needs for money, manpower and leadership. It follows that the leaders at the top must take a general view, but it is vital that at the very next level there shall be the engineering experience of those familiar with the rigours of export markets where, once the credit lines and the government loans have been fixed up, everything turns upon service, upon quality, and upon being one idea ahead of the competition.

Sea Defences and National Interests

"Decisions on coastal defence plans would inevitably be taken out of the hands of local people if the whole financial burden were shouldered by the Government." So said Mr. Henry Brooke, the Minister of Housing and Local Government, when speaking at Clacton-on-Sea on the occasion of a ceremony marking the completion of some local sea-works.

"I think," he added, "that the people who live in the area ought to have an effective say in the planning of sea defences which affect them so vitally." In support of his views, Mr. Brooke quoted the recommendations of a Royal Commission of 1911 and of the committee which sat under the chairmanship of Lord Waverley after the 1953 floods, both of whom decided that coastal protection was a matter in which individual and local and national interests were all concerned, and that therefore the burden of the cost should be distributed between them.

But of all man's activities around the coasts, that of building sea defence work demands the maximum cooperation between neighbouring authorities. The devastating effects that can be generated a few miles away by an essential but faulty construction in one place makes it essential that authorities all along the coast should be aware and conerned with intended works.

Overall control, paying regard to all the coastline, can only come from a central body and it is high time that a central authority for coastal defence work was established.

Keeping up with the Development Programmes

Great Britain's share in the combined East-West operation to help India with what still has to be done in her second five year plan and for the third plan, which begins next year, amounts to £30 million.

The already agreed aid from Russia, Western Germany and the United States brings up to £153 million the total of assistance promised towards the £203 million needed for the third plan. At the time that the United Kingdom's part in the scheme was being made known it was learned in Accra that the Ghana government had contracted with a powerful consortium of West Germany companies for the construction of a number of industrial projects. The German team of companies is to provide a credit of £150 million.

And casting a beneficial shadow over the whole subject of aid to the developing nations is the International Development Association, whose function is to enable the industrialised states to lend money on easier terms to the less advanced.

All of which means that the capital goods industries have the opportunities for very busy times ahead indeed. They are likely to be much in demand as the front line firms at home strive to keep in step with tomorrow, both in plant and techniques, and from Ghana to India and Hong Kong to Dahomey they will be needed for an immense range of constructions.

But there is a snag in this excellent scene. The British £30 million to India will be spent on capital goods to be made in the UK. And the German £150 million will likewise be spent in Germany. In other words the greater the amount of profit which the industrialised nation can made in competition with its equals, the more it can lend abroad, creating in the process the opportunity of further sales, greater profits and wider loans.

The competition in overseas capital constracts is, of course, very keen. Another form of competition is appearing. Since there is something of a buyers' market in capital equipment there is a real temptation for the newer states to bargain sharply over the terms for repayment.

of the New Scottish Venture by Rootes

Long awaited were the plans for future development by the Rootes motor group. Now that they have been at last stated they prove to be in some ways more stirring than all the multi-million pound proposals of the company's bigger brothers.

For one thing, the earlier announcements came when car production was booming and the compacts had not cut across the traffic lane of imported cars moving into the United States. But the chiefs of the Rootes concern are men with long memories as well as present optimism. The car business has its ups and downs, and when sales are so closely related to the state of the hire purchase regulations there is a double relationship between the nation's fortunes and those of the car firms.

High and profitable foreign selling activities by the car firms bring in the money, improve the balance of payments and, incidentally enable the authorities to ease restrictions, so starting a run of home demand for cars, with attendant effects on the import bill.

A daunting world, but not one to daunt the motor makers. The Ford chairman, Sir Patrick Hennessy, discussing the big expansion plans in the north-west and elsewhere has said: "In this business there is nowhere to go but up." The Rootes family feel it would be a bad day for the industry if its leaders had not the courage to build for the future.

The completely new Rootes car to be made alongside the Pressed Steel plant at Linwood means much more than jobs for several thousand Scots workers. Component makers will benefit, some 75,000 of the smaller-than-the-Minx cars (50 per cent of the output) are expected to be sent abroad from the Clyde and the one-model one-factory scheme could keep the cost down and assist in making the car a major asset in world markets.

Making the Thing Look Right

At first glance one of the effects of contemporary design has been to produce refrigerators and domestic boilers that look remarkably alike. Yet both are strictly functional and the unintentional similarity has come partly from getting rid of historical elements in both. In the refrigerator it was the feeling that like its forerunner the food cupboard it had to be bulky and tall. In boilers until very recently there was still the tendency to provide for opening it up and letting it heat the kitchen as well as the water.

The lesson from the outcome of the intense design work put into these two kitchen appliances applies far and wide throughout industry. The accidental bits and pieces clinging to every day objects from their evolution have been usefully removed. It is often a cleaning up that needs the imaginative eye of the artist designer.

In some of the more recent industries equipment seems to have started life with the design advantage of having come late into the field. A good deal of office equipment, the photo-copying machines and certain desks are good examples, have an easy-to-live-with air about them that is a decided advantage in the hectic conditions among which they will be used. Their polished appearance may well have a more easily measured effect. Office machinery export sales continue to rise with gratifying alacrity.

It is a commonplace of criticism that the Swedes, the Czechs, the Italians, in some respects the Americans, have an aptitude for design that the British, self-effacing and modest to a fault, have never cultivated. This may do for a national pose but it sells badly.

After fifteen years of missionary effort by the Council of Industrial Design, there are signs that the importance of appearance and proper functioning of products as widely separated as the fruit bowl and the telephone has made substantial growth. It receives formal recognition, duly celebrated in the 15th annual report of the Council, in the award of the 1959 Gran Premio Internazionale la Rinascente Compasso-d'Oro.

Normally given by the famous Italian store La Rinascente, for an outstanding contribution by an individual or organisation to industrial design, the award to the Council went to "the oldest and most efficient government organisation for the development and popularisation of good design."

and a Chance to Cut Those Delivery Dates

Increasing difficulties in the export markets, satisfaction of a large part of the home demand for new cars, levelling off in the rising rate of British industrial production—all combine to suggest that some important changes will be occurring in the engineering industries over the next few months.

For the moment there is no suggestion that the capital investment programmes of industry are slowing down or to be slowed down. If the home market is not to keep so high a proportion of the total industrial effort tied up there will be that much more room for giving special attention to the conditions of the overseas markets and to getting back to solidly reliable estimates of when the goods will be in the hands of the customer.

A change in the United Kingdom's spending pattern away from personal consumption towards capital investment is exactly what is wanted for reversing the current dismal trend in our trading results.

Compelled by the destruction of the Second World War to rebuild and re-equip their factories, many of Europe's leading companies caught the habit and have been renewing both plant and buildings ever since. The results are common knowledge.

The 1960's are the first decade not predominately "post-war" in character. And finding right at the start that while others bound ahead, British foreign trade has declined, has caused perhaps more genuine doubt and apprehension than all the earlier crises. They could be explained as mere passing phases; this time there is no such easy evasion.

Newly equipped works, a new view of the proportion of output a manufacturer should expect to export, these are essential elements in approaching a situation in which risks and opportunities are almost equally mixed.

Improved Ptfe/Bronze Bearing Materials

Several organisations make bearing materials based on ptfe. In so doing they are exploiting a material with very low coefficient of friction when used dry. 0·04 is about the lowest figure one can obtain—rising to over 0·1 under dynamic conditions.

Unfortunately normal solid sintered ptfe flows under high bearing loads and has low thermal conductivity which implies failure at low *pv* values by overheating—*pv* values being measured in units of lb per sq. in-ft per minute.

How can the *pv* values be increased with low wear rate? Glacier Metal Company and Bound Brook Bearings have incorporated bronze powder and lead in their DU and Polyslip grades respectively. Acheson Colloids use phenol formaldehyde resins to give a skeleton which supports the ptfe in their Emralon dispersons. Polypenco make an undisclosed but reinforced ptfe called Fluorosint. British Belting and Asbestos produce a ptfe-surfaced bearing called Mintex which is based on high strength ptfe fibres obtained from Du Pont.

Of immediate interest is the fact that Bound Brook Bearings have brought out an improved version of their Polyslip bronze and lead-filled materials to be known as 1M. In considering use of such material remember that the wear rate in running-in is high until about 0·001 in has been removed. But once this has happened they will withstand *pv* values of at least 6,500 quite happily under completely dry conditions when operating with mild steel shafts. Bearing lives of 1,000 hours while retaining recommended clearances can be expected, and these are in fact much higher with hardened shafts and lower *pv* values.

Polypenco's Fluorosint and Glacier's DU grades resist wear especially well at *pv* values below 15,000 which are, on paper at least, far higher than for Polyslip 1M. But a strict comparison must involve actual service considerations, such as the nature of the rubbing surface and the effect of "accidental" lubrication whether by water, oil, grease or chemicals.

Contrary to the accepted view that ptfe is affected by dirt and abrasive particles, the makers say that Polyslip 1M is quite well suited to dirty conditions. If this is so, it begins to remind one of cotton/resin bearings like United Coke and Chemicals' Orkot, or Railko bearing materials, which allow dirt to bed down relatively harmlessly in the bearing material.

So long as allowance is made for thermal expansion and contraction on running clearances of bearings made with materials like 1M, they may be used over the whole temperature range of liquid nitrogen (near − 200° C) to about 280° C.

Unlike graphitised bronze bearings, the working surface cannot be machined. The makers have tried to make life convenient for the user, however, by producing internal diameter bearings in 14 steps from $\frac{1}{16}$ in to $2\frac{1}{2}$ in which does allow many one-or-two-off configurations to be produced just with external machining.

More information on other plastic materials which can be used as self-lubricating bearings is included in *Engineering Materials and Design*, Oct., '60, and literature on products mentioned in this note can be obtained from the makers as shown below.

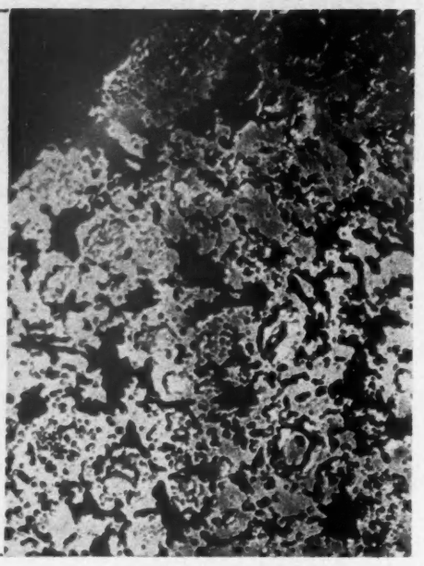
DU material: Glacier Metal Company Limited, Alperton, Wembley, Middlesex.
Polyslip: Bound Brook Bearings Limited, Stratford House, London W1.
Emralon: Acheson Colloids Limited, 70 Hill Street, Richmond, Surrey.
Fluorosint: Polypenco Limited, Welwyn Garden City, Herts.
Mintex: British Belting and Asbestos Limited, Cleckheaton, Yorkshire.
Ptfe fibres: Du Pont Company (UK) Limited, 76 Jermyn Street, London, SW1.
Orkot: United Coke and Chemicals Company Limited, Handsworth, Sheffield, 13.
Railko: Railko Limited, High Wycombe, Bucks.

Where the Makers Would Like You to Consider Polyslip 1M Bearings . . . .

Where there are oil solvents
Where temperatures are high or low (−200° C to 280° C)
Where dust is a problem
Where maintenance must be at a minimum
Where atmospheric pressure and humidity are subnormal
Where oil and grease can spoil the finished product
Where lubricants suffer chemical reaction
Where static electricity is a problem
Where slip-stick motion must be avoided

But Remember . . . .

There's lead in it: so be careful in food machinery
There are cheaper materials in the form of porous bronze oil-retaining bearings for normal dry applications



Use Platinum-clad Steel and Save Money

So you want to enjoy perfect chemical resistance at high temperatures? The answer is certainly not to fly off and order the equipment in pure platinum—but it might well be worth having a look at platinum-clad metals. Texas Instruments have been developing this material for a number of years and are now pretty certain that they can make a material whose surface remains pure platinum alloy even after holding at 860°C for a month. Note that it is a platinum alloy, not pure platinum. However, the addition is half a per cent of rhodium and this reduces chemical resistance negligibly. It is included in order to get a good bond between the top surface and what has been found one of the most satisfactory base materials—carpenter 20 stainless steel.

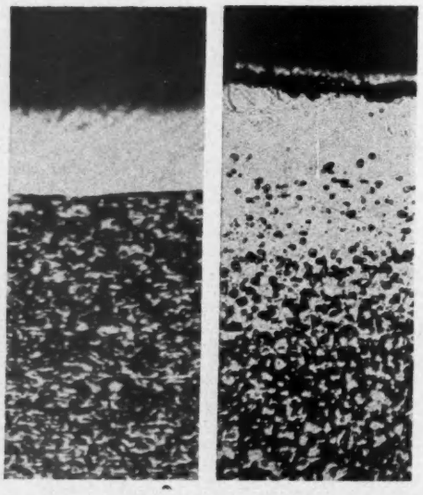
The illustrations on the right are included to show that retaining good corrosion resistance of clad materials is not as straightforward as might be thought. In this case the Texas research men tried several etchants on the polished cross-section to show them what the diffusion was after a month at 860° C. Because of the almost perfect chemical resistance of platinum it is very difficult to show up the structure, and the few pictures they obtained did not all look like the one on the right. Clearly the proof of this pudding will have to be derived from actual corrosion tests on the clad material.

Still, it's here. Not made in the UK by Texas Instruments, admittedly, but certainly obtainable from the USA through them.

Texas Instruments are able to diffusion-bond platinum on to a range of alloys, including copper, nickel, all iron and stainless alloys, and on to tantalum, zirconium, refractory and reactive metals. Typical applications which they quote are electrical contacts, slip rings, rupture discs, electrodes, anodes and cathodes, jewellery and laboratory ware. This is possible because they are able to produce the clad materials as sheet, wire, tube or rod.

Effect on the properties is rather interesting. It is obvious that the mechanical properties more nearly resemble those of the thicker base metal than of the platinum. Hence with steels, it can be structurally strong even at the temperature used for diffusion testing. Electrical and thermal conductivities of platinum are approximately 16 per cent those of silver or copper, so if these metals are used as the base, the corrosion resistance is that of platinum but with greatly improved conductivity for the same thickness.

Platinum cladding thicknesses ranging from 0·0001 to 0·005 in and over can be produced and the version based on stainless steel can be rolled into strip with thickness from $\frac{1}{16}$ to 0·005 in and widths up to 12 in.



This shows the amount of diffusion of stainless steel into the rhodium-platinum alloy surface after a month at 860° C. (Magnification × 500)
Texas Instruments Limited, Dallas Road, Bedford. Data obtained from parent company in USA.

Removal Agents

The two latest developments by Allweather Paints show a thoroughly destructive outlook. Still, when it comes to removing things which shouldn't be there, that is all to the good. Take painting, for instance: it's no good putting the tenth coat on top of the ninth, or the first on top of rust. It's far better to get down to the bare facts and make a fresh start.

To aid in this stripping business, this firm make Pitan paint remover type C, and rust remover with the same name. The big advantage of the first is that no neutraliser, washing or cleaning is required after use since it leaves the surface ready for painting. What is more it will remove even the tough coatings like epoxides and polyurethanes, according to the makers. Rubber based paints, cellulose, and emulsion (pva) paints are said to come off.

Second on the list comes the getting rid of rust. The new remover differs from the majority of other rust removers in that it contains no phosphoric or hydrochloric acids. It is non-combustible and non-toxic.

Laboratory research and practical application of Pitan rust remover has revealed that this solution removes rust efficiently from the interior of closed systems such as turbines, fresh water systems, boilers, sterilisers, sprinkler systems, fire mains, heating systems, large and small engines, storage tanks, circulating systems, and any other closed unit of equipment or closed piping system that would be impractical to clean by mechanical or conventional chemical methods. If you have as many systems as in the last paragraph you will probably be systematic enough to buy some of these materials to try them. For the latter there are lowered prices for trial quantities.

Allweather Paints Limited, 36 Great Queen Street, London, WC2.

Quick Drying Red Lead Paint

Smooth . . . smooth in the pot and smooth on the surface. For red lead primers that is not a bad recommendation, for two annoying habits of such material are its tendency to cake-up and settle in the pot and the valleys formed in the finished coating. Fenal is the coating, made by Fenner and Alder.

Now add to its smooth consistency and surface the fact that this primer will surface dry in 3 hours and be ready for the next coat in 8 hours —referring to winter conditions—and one can see why the makers think they have a winner. For best performance you can expect to put on two coats at the covering rate of about 40 to 50 sq. yards to the gallon (this was obtained on ships' topsides and similar large areas using strikers); using ordinary brushes on a correctly prepared surface a higher rate can, of course, be expected. Just in case you are suspecting that absence of settling implies that there is very little red lead in the primer, the figure to look at is 55 per cent—which is high.

Fenner and Alder Limited, Millwall, London, E14.

Thick Coatings With Anodic Paint

Heres an improved version of an old product—a liquid metal paint which protects iron and steel structures by being anodic to it. This new product is called Metalife Duplex. It is a two pack system consisting of a base and a solidifier which when combined give a metal coating which has exceptional resistance to corrosion, abrasion, solvents and chemicals. It withstands temperatures from −65 to 400° F (dry heat) and is non-toxic.

There are also other advantages which go along with the new material. To start with it gives in one brushed application a double thickness coating, which means that where normally four protective coats would be required, only two coats will now be needed. This automatically halves the application time, say the makers, which is a significant factor for contractors or where working plant is involved with consequent labour costs. The coating is also quick drying—it can be overcoated in six hours.

A double thickness coating would mean half the coverage but for some reason this gives 10 per cent over half—an actual coverage of 1,400 sq. ft per cwt. In two coats of the Duplex material it is possible to deposit 2·1 oz of anodic metals per sq. ft, equivalent to good quality galvanising.

There are still two more advantages. Firstly it will go on damp surfaces and won't sag, drip or run when being applied. Secondly, it won't settle which, if true, gives it quite an advantage over other products of this type.

Metalife Liquid Metals Limited, Harrogate, Yorkshire.

200 Miles of Stainless Tubing

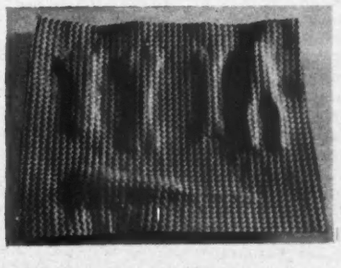
Two hundred miles equal a million feet. Perhaps, however, neither figure is easy to grasp when talking about stainless steel tubing. It's long. The makers of the tubing are Wallingford Steel, an Allengheny Ludlum Steel subsidiary in the USA who will use the AISI type 304. This is 18Cr-10Ni-stainless steel.

It will go into 10 steam generating units now being made for the American Atomic Energy Commission's plutonium plant at Richland, Washington. Wallingford produces the tubing from strip 3·8 in wide which is formed into tubing and welded without filler rods. After annealing and redrawing it finishes up with a wall thickness of 0·049 in with an outside diameter of $\frac{5}{8}$ in.

Allegheny Ludlum Steel Corporation, Pittsburgh 22, Pa., USA

Dispatch Quickly in Sticky Strawpaper

For " sticky " read " self-adhesive "—the idea is certainly not to get all gummed-up. Spicers' new product, which is based on a crinkled strawpaper, looks just the right material for making spanners into squares so that they will fit into standard envelopes for dispatch. What is more, it can be used over and over again if you



are careful not to tear the material when separating the two blankets.

Shown hibernating in the illustration below is a selection of small tools held firmly in place between the blankets of strawpaper. But to the facts: this double-waved material called Carbion is now made self-adhesive with an uncured rubber coating derived from a latex. It can thus be stuck back on itself to make an envelope while retaining articles inside. The latex won't damage metal surfaces by corrosion so it doesn't matter that the adhesive comes in contact with the articles. Strength of the adhesive has been matched with that of the paper so that it will bond strongly when the double-weave is stretched around bulky tools, but will normally allow the paper to be pulled apart to be reused without odd bits of strawpaper staying on the tool.

Standard rolls are 42 in wide and 200 ft long (unwound). Spicers will also make it in other materials on special order and arrange for it to be overprinted.

Spicers Limited, Loughton, Essex.

Intermetallic Semiconductors

Johnson, Matthey announce that they are now producing very pure arsenic, antimony, tellurium and bismuth on a commercial scale. By means of newly developed techniques, arsenic is being produced with an impurity level of the order of 1 p.p.m., detected by use of present known and accepted spectrographic methods. The element is in the form of crystalline lumps and is packed in vacuum-sealed glass tubes.

Antimony, with a maximum metallic impurity content of 5 p.p.m., and bismuth, with a maximum level of metallic impurities of 10 p.p.m., are being produced in ingot form. Zone-refined tellurium, with a metallic impurity content of the order of 1 p.p.m., is also available in bulk, in the forms of ingot or grain.

Of increasing importance to the semiconductor industry, these four high purity metals find growing application in the form of intermetallic compounds. For example, gallium arsenide is used in the production of special diodes and transistors, indium antimonide and indium arsenides are used for magneto-sensitive devices and bismuth telluride in Peltier cooling units.

Johnson, Matthey and Company Limited, 78 Hatton Garden, London, EC1.

Urethane Foam Keeps Out Dust

Pye of Cambridge have solved dust exclusion for their Scalamp galvanometer in a very simple way: they have used Tessamoll urethane foam as a backing and sealing for the slow motion zero head and spirit level, both of which protrude through the casing of the instrument.

The characteristic gentle push-back of urethane is said to be ideal for this purpose as it presses gently against the inside of the casing to exclude dust without exerting any appreciable pressure on the casing or the components it is protecting. Being electrostatically negative the urethane seal tends to repel dust and other particles, giving additional value to its physical, dust sealing quality.

This self-ashesive foam has been used in many ways in industry, such as sealing cathode tubes against dust, and as seatings for electronic instruments, flash light equipment and cameras, just to mention a few. It is available in a wide range of widths, thicknesses and lengths.

Sealdraught Limited, Buckingham Gate, London, SW1.

Protective Film For Graphite Ceramic

Anyone in the know will point out drawbacks to use of graphite as a high temperature material. To start with, its strength of around 2 tons per sq. in. at 1,000° C—it rises with temperature—is still low compared with nickel and cobalt base alloys (the new Nimonic alloy 115, even at the top of its working range, will withstand 7 tons per sq. in for 35 hours at 1,000° C). But by far its greatest shortcoming is its lack of oxidation resistance. So it is encouraging to note that material research engineers at Boeing Aero-Space Division in Seattle are working on a composite graphite ceramic which forms a self-healing film under oxidising conditions. This is reported in the August 1960 issue of *Ceramics Age*.

A typical composition consists of 50 per cent graphite, 24 per cent molybdenum disilicide and 25 per cent titanium boride, the last two of which are well known oxidation resistant materials in their own right. The protective layer is said to develop at around 1,200° C appearing in one composition as a smooth, adherent, non-porous yellowish-brown film about 0·001 in thick.

Plain Words

By Capricorn

WHAT precisely do engineers do? How would you explain the nature of their work? I raise the question because the public generally have only a hazy notion.

We must dismiss as useless those replies of the form "I design and build bridges" because everyone knows that one man cannot do all the drawings for a bridge, and because everyone has been told often enough that the men who actually do the physical work of construction are not engineers. In fact that is one of the main reasons why the public's image of the profession is unformed and uncertain. There is a plaintive, negative chorus of "We don't do *that*," followed by a silly silence on what we do.

This scandalous situation contrasts sharply with the positive images evoked by other professions. (The fact that the image is often rather wide of the mark is unimportant.) The family doctor is seen as a man of superior training and education who applies his scientific knowledge of the human body to the cure of one's ailments (most of the time he is actually practising as a common-sense self-taught psychologist trying to persuade your mind to do the work of healing for him).

The barrister is an eminently articulate gentleman who amuses judges and jurymen with his quick wit and his curious one-sided view of a case (most of the time he is twiddling his thumbs waiting for a brief or burning the midnight oil coming to grips with all sides of the case).

The clergyman is a religious-minded chap who tells us how we ought to live (most of the time the poor fellow is bustling around unravelling the petty tangles left by his well-meaning parishioners). The soldier is a fearsome, fearless officer and gentleman who leads his troops into battle (most of the time he is sitting at a Desk, 6 ft, folding flat, trying to understand how he is to apply the latest Army Council Instruction).

And so we could list them all—schoolmasters, architects, interior decorators, photographers—we know what they do, or we think we do. Accountants are probably the only ones who actually do what they seem to do: play a very elegant, sophisticated and complicated game with the Commissioners of Inland Revenue.

Come closer to the engineering profession: to scientists. The word conjures up an image because our science masters, and now our television screens, have fooled us into imagining that we know what scientists do. But engineers! The trouble is that no one has actually seen an engineer at work.

The engineer combines something from each of the professions: a little amateur psychology to get others to do the physical work; burning the midnight oil to grasp the meaning of a technical report; unravelling other folks' tangled messes; sitting a ta desk trying to interpret a board instruction; even playing that game with the Commissioners of Inland Revenue.

Letters to the Editor

What to Read

SIR, Mr. F. Machon, in his letter (ENGNG., 23 Sept. '60, p. 405) commenting upon my article "Deciding What to Read to Keep Informed," stresses the importance of delegating the scanning of literature "where at all possible." I entirely agree, subject to the proviso that the individual, however good the literature scanning services available to him are, should nevertheless do some personal reading of current literature. Mr. Machon suggests two key journals as a reasonable number; I put it a little higher.

But delegation is by no means always possible. The case of the individual engineer dependent largely upon his own efforts to secure information is surely not "rather unusual." It is very common. Whereas there are well under a thousand large industrial organisations in the country with their own libraries or information sections, there are many times that number of small organisations in which one or two engineers must cope with the literature themselves because they have no one to whom they can safely delegate it.

My article was specifically directed to people in this situation. Most of the papers published on the handling of technical information relate primarily to the problem of the larger organisations which have already established some form of library or information service. I attempted to redress the balance by providing practical suggestions applicable to the problems of the engineer in the small organisation.

Yours faithfully,
C. W. HANSON,
Head of Research.

Aslib,
3 Belgrave Square, London, SW1.
26 September, 1960.

Mixing Gases

SIR, May I comment on Mr. P. Chambadal's article on "Mixing Gases and Gibbs' Paradox" (ENGNG., 16 Sept. '60, p. 398)?

Two points of principle first arise. In the discussion of Fig. 2, surely changes of internal energy should be considered and not changes of enthalpy. Also, is it not questionable to introduce equivalent (?) throttling processes (which relate to steady-flow conditions) in the analysis of an essentially non-flow process?

Gibbs' paradox rests upon the inability of equation (2) to display by its notation any differences of nature between the two gases. However, it must be remembered that this equation was founded on a two-compartment system which was assumed to be rendered macroscopically out of equilibrium by removal of the dividing membrane. If the gases in the two compartments are in fact identical in composition and state, then removal of the membrane will *not* create the necessary non-equilibrium state.

In these circumstances, equation (2) is surely irrelevant and inapplicable, even though—as one might say, from no fault of its own—it appears incapable of discriminating between the two situations. Moreover, does not the very concept of partial pressures (which is embodied in equation (2)) become vague to the point of meaninglessness in the case of a one-gas system, the molecules of which are totally indistinguishable from one another?

Notwithstanding this, much may be adduced in support of Mr. Chambadal's concluding statement. That the mixing of dissimilar gases entails an increase of entropy is widely held and not easily refuted. But, on the question of causing available energy to materialise as mechanical work by means of such processes as discussed for Fig. 2, normal methods of analysis readily show that if the system, with membrane left intact, were brought to pressure and temperature equilibrium with the ambient atmosphere, the amount of work realised would be identical with that obtained from an initially fully-mixed system. This procedure is perhaps a less controversial way of reaching Mr. Chambadal's conclusion.

The author assumed perfect gases, and the above remarks accord with this. Discussion of real fluids might well lead to modified conclusions regarding available work.

Yours faithfully,
BORIS N. COLE,
Reader in Mechanical Engineering.
The University of Birmingham,
Edgbaston, Birmingham 15.
30 September, 1960.

Ultra-Low Temperature Insulation

SIR, On reading the article entitled "Insulation for Ultra-Low Temperatures," by Mr. J. W. Dawson, of Stillite Products Limited (ENGNG., 16 Sept. '60, p. 370), in which he mentions our materials "Onazote" and "Polyzote," we would draw your attention to the following discrepancies:—

"Onazote" is not foamed Bakelite, as stated in your text, but expanded ebonite. The price is not 18*s* per cu. ft, as stated, but 13*s* per cu. ft.

"Polyzote" (expanded polystyrene) is manufactured by our associate company, Expanded Plastics Limited and not by Expanded Rubber Company Limited as shown in your table.

Yours faithfully,
W. MILLER,
Manager.

Insulation Department,
Expanded Rubber Company Limited,
Mitcham Road, Croydon.
30 September, 1960.

Radio's New Dimension

SIR, May I hasten to correct a slight misstatement in the article entitled "Space Flight Gives Radio a New Dimension" (ENGNG., 9 Sept. '60, p. 340)?

The three Hawker Siddeley satellites mentioned are obviously those referred to in our recent paper read at Stockholm. With three satellites we can give 24 hours a day coverage to the entire Northern hemisphere down to latitude 40° N and with three more satellites in an equatorial plane we can give world-wide coverage between latitude 52° N and 52° S during the twelve daylight hours at any given place. These particular orbits have about four times the load-carrying capacity of the twenty four hour "stationary" orbit if the same launching rocket is used in both cases.

Yours truly,
W. F. HILTON.

Astronautics Division,
Advanced Projects Group,
Hawker Siddeley Aviation Limited,
Richmond Road,
Kingston-on-Thames.
27 September, 1960.

Air Flow in Fruit Stores

SIR, In your recent issue there is an account of a paper read to a meeting of the Institute of Refrigeration on the construction of cold stores for fresh fruit and vegetables (ENGNG., 16 Sept. '60, p. 389).

This function was an all-day meeting, held at the Ditton Laboratory, to which members of the Institute, representative fruit growers and members of the National Agricultural Advisory Service were invited.

The meeting was primarily an engineering occasion; I am a biologist. Although the paper was attributed to me, all I did was to introduce the topic, by citing the conditions which biologists demand from the engineer who constructs the store. The paper you quoted was actually read by my colleague, Mr. G. Mann.

There were two further papers, one by Mr. E. S. Green, of J. and E. Hall Limited, and the other by Mr. A. C. Murdoch, of Pressed Steel Company Limited, describing the methods of construction and operation used by their companies.

At the Ditton Laboratory, biologists and engineers work closely together. Successful storage of English-grown fruit demands close tolerances of conditions; this meeting was most useful in demonstrating to growers the way in which research and practice in this field are closely linked, and was a means of giving the farming community an opportunity of having some of their difficulties resolved.

Yours faithfully,

J. C. FIDLER.

Agricultural Research Council,
Ditton Laboratory,
Larkfield, Maidstone, Kent.
29 September, 1960.

Rain in Australia

SIR, I read with interest your short article on artificial rainmaking (ENGNG., 9 Sept. '60, p. 353). However, I trust that the tank and auxiliary equipment are not used in the position shown in the photograph.

Inverted flying is uncomfortable enough without having to indulge in it in or around large cumulus clouds where the bumps experienced would make the weight on the straps even more uncomfortable.

Or perhaps the old adage of things being upside-down in Australia really applies.

Yours truly,

RONALD A. KIRKIN.

Le Breton Farm,
Manor Way,
Lee-on-the-Solent.
27 September, 1960.

Events in Advance

Training Today for Tomorrow

IN HIS foreword to a booklet giving a general outline of the arrangements for the United Kingdom's forthcoming Commonwealth Technical Training Week, the Duke of Edinburgh makes the point that the week is intended "to draw attention to the very wide range of apprentice schemes and technical training programmes which are open to bright and ambitious young people."

The idea of holding such a week originated in Australia, where, during his tour, the Duke saw a State Apprenticeship Week in operation and felt there was a conception which could be immensely valuable throughout the Commonwealth, varied no doubt to suit the circumstances and needs of individual territories. Back in London, the suggestion found a ready acceptance and a meeting was duly held at Buckingham Palace in May last year at which the Duke presided in his capacity as President of the City and Guilds of London Institute. The meeting was attended by the High Commissioners of Commonwealth governments and by many representatives of the British Government, local authorities, national organisations and industrial firms. The proposal was warmly accepted and the Institute undertook responsibility for the central organisation.

It is intended that the week shall cover all forms of training for employment, including, of course, training for apprentices and learners, operative training, induction training, and training for agriculture, commerce and the professions. Training is normally given either in a firm or in an educational establishment, or perhaps more usually, in both. The organisers feel, therefore, that industry, commerce and education must all play their parts to the full if the week is to be a success.

The organisation of the week provides for a central advisory committee to deal with general policy and a United Kingdom committee to look after arrangements in this country. There are also Scottish, Welsh, and Northern Ireland committees, charged with making arrangements in those areas.

At district level, the organisation of the week is in the hands of the local authorities and it is considered that the best results are most likely to be achieved by their setting up *ad hoc* committees of local people representative of the interests in their districts. Among the activities suggested by the central committee are open days, prize givings, exhibitions of work, displays, competitions, film shows, careers exhibitions and conventions, and sports days.

In the United Kingdom, the week will cover the period from 29 May to 4 June, 1961. The secretary is Mr. C. B. McAlpine, C.B.E., City and Guilds of London Institute, 76 Portland Place, London, W1.

Meetings and Papers

British Institution of Radio Engineers

LONDON
"Electro-Acoustics for Human Listeners," by Professor Colin Cherry. Inaugural Meeting of the Electro-Acoustics Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 12 Oct., 6.30 p.m.*
NEWCASTLE UPON TYNE
Film Display. North Eastern Section. Neville Hall, Westgate Road, Newcastle upon Tyne. Wed., 12 Oct., 6 p.m.
WOLVERHAMPTON
"Electrical Synthesis of Music," by Alan Douglas. West Midlands Section. College of Technology, Wulfruna Street, Wolverhampton. Wed., 12 Oct., 7.15 p.m.

Building Centre

LONDON
"Colour for a Lifetime": film, exhibited by Richards Tiles Ltd. Wed., 12 Oct., 12.45 p.m.

Combustion Engineering Association

GLASGOW
"Factors Affecting the Choice of New Boiler Plant": Discussion to be opened by R. Bunting, at 10.30 a.m.* "Ability of Mechanical Stokers to Comply with the Clean Air Act": Discussion, at 2 p.m. Grand Hotel, Charing Cross, Glasgow. Wed., 12 Oct.

Institute of Marine Engineers

LONDON
"Service Results with the Mitsubishi Nagasaki Diesel Engine," by H. Fujita. Tues., 11 Oct., 5.30 p.m.*
BRISTOL
"Corrosion and Fires in Marine Boiler Air Preheaters," by A. Bell. West of England Section. The University, University Walk, Bristol 8. Mon., 10 Oct., 7.30 p.m.
GLASGOW
"Rationalisation in the Marine Engineering Industry," by T. W. D. Abell. Scottish Section. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Wed., 12 Oct., 7.30 p.m.

Institution of Chemical Engineers

LONDON
"Surface Effects and Liquid Behaviour": Symposium. Royal Institution, Albemarle Street, W1. Mon., 10 Oct., 3 to 7 p.m.

Institution of Civil Engineers

LONDON
"Fire Resistance of Prestressed Concrete Beams," by L. A. Ashton and S. C. C. Bate. Tues., 11 Oct., 5.30 p.m.*
"Economic and Efficient Traffic Surveys": Discussion introduced by F. Garwood. Traffic Engineering Study Group. Thurs., 13 Oct., 5.30 p.m.*

Institution of Heating and Ventilating Engineers

BRISTOL
"Steam for Process," by L. G. Northcroft. South Western Branch. Main Lecture Theatre, The University, Bristol. Wed., 12 Oct., 7.15 p.m.

Institution of Mechanical Engineers

LONDON
Automobile Division Annual Meeting and Chairman's Address. Tues., 11 Oct., 6 p.m.*
"Inspection of Nuclear Power Plant," by H. N. Pemberton. Wed., 12 Oct., 6 p.m.*
ASHFORD
"Modern Aids in the Design of Railway Bogies," by A. W. Manser. Southern Branch. Saracen's Head Hotel, Ashford, Kent. Thurs., 13 Oct., 7.30 p.m.
CAMBRIDGE
"Photographic Techniques in Engineering," by P. H. Herbert. Eastern Branch. Engineering Laboratory, The University, Cambridge. Thurs., 13 Oct., 7.30 p.m.

Institution of Plant Engineers

LONDON
"Plant Engineering on the Continent": Discussion. Royal Society of Arts, John Adam Street, Adelphi, WC2. Mon., 10 Oct., 7 p.m.*
GLASGOW
"Fire Wastage and the Plant Engineer," by G. W. Browning. Glasgow Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow. Thurs., 13 Oct., 7.15 p.m.
NEWCASTLE UPON TYNE
"Materials Handling," by E. R. C. Farmer. North East Branch. Roadway House, Oxford Street, Newcastle upon Tyne 1. Thurs., 13 Oct., 7 p.m.
NOTTINGHAM
"The Yorkshire Motorway" (with film), by J. Michie. East Midlands Branch. County Hotel, Theatre Square, Nottingham. Wed., 12 Oct., 7 p.m.
SCUNTHORPE
"Design and Maintenance of Heavy-Duty Gears," by G. D. Parkinson. Sheffield Branch. Blue Bell Hotel, Scunthorpe. Thurs., 13 Oct., 7.30 p.m.

Institution of Production Engineers

ACCRINGTON
"Investment Casting," by M. Riddihough. Preston Section. Accrington College of Further Education, Sandy Lane, Accrington, Lancs. Wed., 12 Oct., 7.30 p.m.
MANCHESTER
"Rail Traction Diesel Engines: Design for Production," by T. E. Draper. Manchester Section. Manchester College of Science and Technology, Manchester. Mon., 10 Oct., 7.15 p.m.

Institution of Structural Engineers and Société des Ingénieurs Civils de France (British Section)

LONDON
"Prestressed Concrete Pressure Vessels for Nuclear Reactors at Marcoule," by Jean Bellier and Max Tourasse. 11 Upper Belgrave Street, SW1. Thurs., 13 Oct., 6 p.m.*

Institution of Structural Engineers

GLASGOW
Chairman's Address, by N. M. Brydon. Scottish Branch. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Mon., 10 Oct., 7 p.m.

Junior Institution of Engineers

LONDON
"Nuclear Fuels," by Robin F. W. Guard. Fri., 14 Oct., 7 p.m.*

Reinforced Concrete Association

BIRMINGHAM
"Lift Slab Design and Construction," by F. R. Benson. Midland Counties Branch. Birmingham and Midland Institute, Paradise Street, Birmingham. Tues., 11 Oct., 6 p.m.

Royal Statistical Society

LONDON
"Professional Earnings," by W. F. F. Kemsley. General Applications Section. Royal Institute of Public Health and Hygiene, 28 Portland Place, W1. Tues., 11 Oct., 6.15 p.m.*

Sheffield Metallurgical Association

SHEFFIELD
"Development and Application of X-Ray Fluorescence in the Analytical Field," by D. F. Sermin. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 11 Oct., 7 p.m.

Society of Instrument Technology

LONDON
"Transistor Switches in Monitor and Control Systems," by W. A. Ross. Control Section. Manson House, 26 Portland Place, W1. Thurs., 13 Oct., 7 p.m.*
BIRMINGHAM
"Fundamentals of Temperature Measurement," by E. B. Jones. Midland Section. Gosta Green College of Technology, Aston Street, Birmingham. Fri., 14 Oct., 7 p.m.*
MANCHESTER
"Data Handling and Processing," by E. K. Robertson. Manchester Section. College of Science and Technology, Sackville Street, Manchester. Wed., 12 Oct., 6.45 p.m.
MIDDLESBROUGH
"The Errors of Instruments: Their Study and Importance," by H. Kenney. Tees-Side Section. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. Thurs., 13 Oct., 7.30 p.m.

Television Society

LONDON
"Automation in Television Presentation," by T. A. H. Marshall. Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, WC2. Thurs., 13 Oct., 7 p.m.

Women's Engineering Society

LONDON
"Use of Microwaves in Telecommunications," by J. Rice. London Branch. Hope House, 45 Great Peter Street, SW1. Wed., 12 Oct., 7 p.m.*

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Building Centre, 26 Store Street, London, WC1. (MUSeum 5400)
Combustion Engineering Association, 70 Jermyn Street, St. James's, London, SW1. (WHItehall 5536)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. (BELgravia 3647)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Statistical Society, 21 Bentinck Street, London, W1. (WELbeck 7638)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Société des Ingénieurs Civils de France (British Section), 82 Victoria Street, London, SW1. (VICtoria 6838)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
Television Society, 166 Shaftesbury Avenue, London, WC2. (TEMple Bar 3330)
Women's Engineering Society, 25 Foubert's Place, London, W1. (GERrard 3212)

DRUM SANDER

Quick Change Bands

QUICK changing of the bands and a true working surface are two of the claims for a new rubber drum sander now on the market.

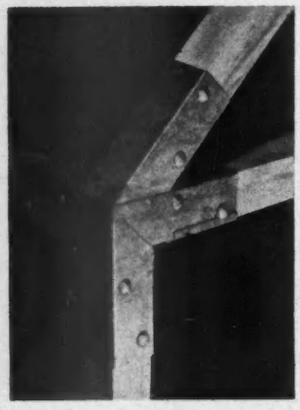
The sander is designed for use with portable tools running at high speeds. The rubber drum is so made that when running it expands by centrifugal force and so grips the abrasive band that fits tightly on it. This method of gripping eliminates clamping devices with their associated demand for screwdrivers, and also removes the risk of deformed surfaces caused by uneven tightening of the clamp.

The band is simply slipped over the drum while the tool is stopped and is automatically gripped when the tool is started. Changing is therefore very quick allowing proper grits to be used without wasting time. Moreover, the working face remains true during the operation so that the whole face of the drum can be used efficiently, spreading the wear over the band and getting the most out of the abrasive.

The higher speeds employed in these tools are ideal for abrasive cloth bands resulting in improved cutting properties and faster production times. The slots in the rubber drum that allow it to expand also allow air to enter behind the band, improving the cooling and prolonging both band and drum life. Three sizes are made, 1 in and 2 in diameter both with 1 in wide faces and $\frac{1}{4}$ in shank, and 4 in diameter with $1\frac{1}{2}$ in face and $\frac{1}{4}$ in shank. The speeds for the three bands are 10,000 to 20,000 r.p.m., 5,000 to 12,000 r.p.m., and 3,000 to 9,000 r.p.m., respectively. *B. O. Morris Limited, Morrisflex Works, Briton Road, Coventry.*

JOINTING SLEEVES

For Timber Structures



GIBJOINTS are metallic sleeves designed to simplify and strengthen timber structures.

The illustration shows one of the forms, of which there are ten available. They are sold singly or in sets to make a complete structure. They are made of 20 s.w.g. steel welded and hot dip galvanised to give permanent rust protection. The standard size will take timber 2 in by 2 in, or 3 in by 2 in by slitting up the joist and allowing the extra inch width to run outside the sleeve.

In order to assemble the structure the sized timber is simply inserted in the joint and held in place by bolts and nuts. Holes $\frac{1}{2}$ in diameter are drilled in the timber for these fixing bolts. The bolts can also be used to secure cladding if they are long enough (or the cladding is thin enough).

Besides the four-way joint with one at 45° as shown, there are three-way, 90°, open T's, four-way with one at 30°, four-way with the two main members at 120° (for ridge fittings), angle plates, two-way for intermediate rafters, and two four-way types for lean-to shed construction. It is claimed that these joints are stronger as well as simpler than hand made ones; nor do they demand the same skill. *Gib Joints Limited, 44 High Street, Harrow, Middlesex.*

MOBILE CRANE

Hydraulic Luffing

WITH 4 tons capacity the new Staffa mobile crane will luff under full load.

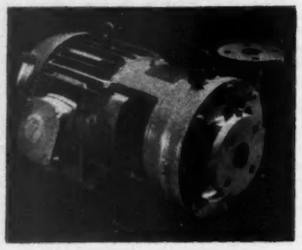
The crane has been designed for easy access and has an overall height of 10 ft 3 in. It will pass along a 6 ft 6 in gangway and turn in 13 ft. An extension is available for the jib to give a greater lift and a swan neck version for handling timber and bulky loads.

Power is supplied by a Ford Dexta engine developing 27 b.h.p. at 1,500 r.p.m. Consumption is about 2 gallons per 8 hour working day. Transmission is by a single dry plate clutch and gearbox the maximum travelling speed being 12 m.p.h. unladen.

A double action hydraulic ram operates the luffing gear with an automatic safety valve to lock the jib in the event of pressure failure. Hoisting speed on a single fall of rope is 42 ft per minute. All motions can be operated independently. With the standard jib the capacity is 4 tons at 3 ft clear outreach and $1\frac{1}{2}$ tons at 10 ft outreach. All loads can be lifted standing free on the wheels. *Chamberlain Plant Limited, Crown Works, Southbury Road, Enfield, Middlesex.*

CENTRIFUGAL PUMPS

Up to 5 in Size



A NEW range of single stage motor driven centrifugal pumps is now on the market.

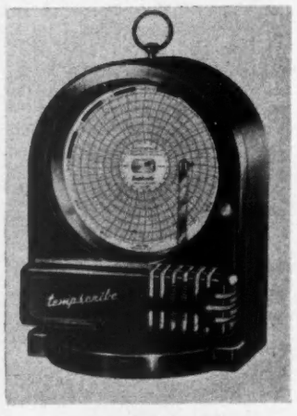
The pumps, to be known as the Alcon Thames range, include six models for 1, 2, $2\frac{1}{2}$, 3, 4 and 5 in pipes. Deliveries range up to 750 gallons per minute at total heads up to 350 ft. The maximum pumping temperature is 225° F and the maximum allowable suction pressure is 30 lb per sq. in. Maximum lift without loss of performance is 15 ft.

Pump casings are made from close grained cast iron and can be arranged for horizontal or vertical discharge as required. The impeller is of gunmetal, hand finished and balanced. There are passages through the hub to relieve the stuffing box pressure and to give hydraulic balance. The impeller rings are of gunmetal also, and are renewable. A bronze sleeve, also renewable, extends through the stuffing box protecting shaft and the gland is gunmetal. A rubber water thrower is fitted. Alternatively, all-iron pumps can be supplied and rotary mechanical seals can be fitted.

The standard motor has carcase and end shield of cast iron. The stator is rated for 3 phase 50 cycles with class E insulation. The squirrel cage rotor runs in single row deep grooved ball bearings, grease lubricated. The motors are totally enclosed and fan cooled. The 1 to $1\frac{1}{2}$ in size pump can be supplied with a single phase or a three phase motor for 230 V or for 400-440 V respectively; the others are normally supplied for three phase only. Petrol and diesel engine driven versions are obtainable. *Arthur Lyon and Company (Engineers) Limited, 6 Carlos Place, Grosvenor Square, London, W1.*

RECORDER

Self-Contained and Portable



RECENTLY introduced are the Temscribe portable temperature and operation recorders.

The instruments are designed for general use and models are available for recording ambient temperature, for remote temperature recording, for operation recording, and for the simultaneous recording of both operations and temperature. The size is small; overall dimensions are $5\frac{1}{2}$ in wide by $4\frac{1}{2}$ in deep by $7\frac{1}{2}$ in high. They consist basically of two parts: the Bakelite case containing the spring driven clock mechanism and the door panel carrying the pen and actuating mechanism.

For ambient temperatures, the door contains a bimetallic element. For remote temperatures a bulb element is connected to the door by capillary tubing, while for operational work an electromagnetic armature is used. The door units are interchangeable.

The charts are $4\frac{1}{2}$ in diameter; those for temperature are made in 13 ranges covering from −30° F to 160° F, and periods of from 4 hours to 7 days. For operation recording, there are three charts covering 4, 8 or 24 hours, and for combined recordings there are two charts, both for 24 hours and for temperatures from −30° F to +120° F. *Shandon Scientific Company Limited, 6 Cromwell Place, London, SW7.*

ELAPSED TIME INDICATOR

Electrochemical

TOTAL operation time of electrical equipment can be recorded on the Selachron range of indicators.

These units have been designed in forms suitable for either d.c. or a.c. operation and in sizes for use with voltages from 6 to 300. They thus do not require relays or switches and can be wired direct to the terminals of the equipment being timed.

There are no moving parts in the indicators which consist of cartridges containing small replaceable electrochemical cells embodying an anode, cathode, and electrolyte. The anode is consumed as the current passes through the cell, the length diminishing in proportion to the hours of operation. A calibrated scale is mounted alongside the anode to read off the hours used. The indicators measure only $2\frac{1}{2}$ in long and are 1 in diameter; they weigh less than 2 oz each and so can be used in confined spaces. *Industrial Instruments Limited, 9 Paved Court, Richmond, Surrey.*

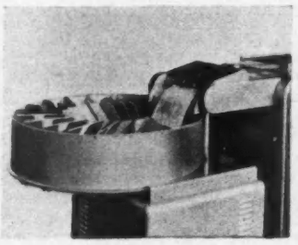
COLLATOR

Up to 20 Sets of Papers

A DOCUMENT collator has been produced which is designed to work in conjunction with a dyeline printer.

The Azoflex 150 is capable of collating up to 20 sets of documents, with each set consisting of many copies, at a rate of 1,500 copies per hour. It is primarily intended to work in sequence with the Azoflex 150 dyeline printer. The collator consists of a round drum mounted on a vertical spindle and divided into 20 compartments. An indexing mechanism rotates the compartments in synchronism with the dyeline printer.

For a full set of 20, the operator sets the counter to 20 and feeds the first original (the last page of the final collation) into the photoprinter. As the first print is produced a pair of switches is thrown and the drum commences to revolve in steps of one compartment. When the drum has made a full circle the cycle starts again with the printing of the next page. When there are more than 20 sets to be collated, the operation is carried out in two stages.



When less than 20 sets are required the counter is set to the number. The drum rotates that number of compartments to receive copies of the first sheet and then reverses back to the first compartment to receive copies of the second sheet. The action is repeated for each sheet of the set.

In addition to being used in its full purpose as a collator, the machine can be used merely as a collector and store for documents as they are printed on the dyeline machine. The sizes it will take cover the whole range that can be printed on the 150 machine. The collator is available for hire as well as for outright purchase. *Ilford Limited, Ilford, Essex.*

SYNCHRONOUS TIMER

Handsetting

THE synchronous timer type NRH is designed for process controls where the operating time is hand set for each cycle.

The timer is driven by a miniature synchronous motor and the time setting is done by turning the knob on the dial to point to the required period. While the timing is in progress the pointer travels back to the zero position indicating the unexpired time. On reaching zero, internal contacts are opened and the timer motor stops.

The motor drives through a friction clutch and the shaft has continuously adjustable timing cams that operate sets of contacts. The contact piles have snap action to allow setting by turning the pointer. The standard unit has two changeover switches only, but up to 12 timed circuits and 12 change-over switches can be fitted.

Timing periods can be selected for almost any range from 0 to 30 sec up to 0 to 12 days. The units are intended to operate from single phase supplies at

400 to 440 V or 200 to 250 V. Standard switching capacity is 6 A at 230 V a.c., but contacts up to 12 A at 230 V a.c. can be provided. The containing cylinder is 3½ in diameter and projects 4$\frac{5}{16}$ in behind the panel. *Electrical Remote Control Limited, The Fairway, Bush Fair, Harlow, Essex.*

CUTTING-OFF MACHINE

Insulating Sleeves

INSULATING sleeving can be cut to required lengths at high speed in a new machine.

The operation is fully automatic and production rates are high. One-inch lengths can be produced at the rate of 50,000 per hour. Moving parts in the machine have been reduced to a minimum and it is particularly stressed that there is no reciprocating mechanism.

Power is supplied by a ¼ h.p. motor and the range of lengths that can be cut is from $\frac{1}{16}$ in to 10 in in the No. 1 machine and from 9 in to 36 in in the No. 2 machine. Different cutters are required or each size but they can be changed in a few seconds. The cut lengths of sleeve are discharged into a container in the lower part of the cabinet and can be removed as required. No attention is needed after the machine has been loaded until the reel is exhausted. The floor space occupied is 2 ft by 1 ft 6 in and the standing height is 4 ft 8 in. *Richmond Designs (Christchurch) Limited, High Street, Christchurch, Hampshire.*

POWER PACK

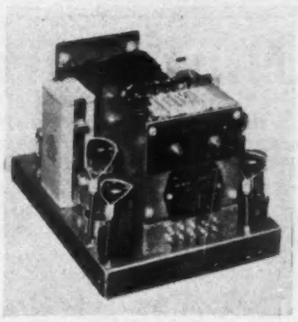
Stabilised Chassis Unit

THE type DC 105 twin stabilised power unit is designed for general purpose use with electronic equipment.

The unit will provide positive and negative d.c. anode voltages as well as 6·3 volt a.c. for heater supply. It is built as a chassis unit for incorporation in the cabinet of larger equipment, but can also be used in the laboratory as it stands. It is claimed to be an economical source of power.

Outputs are ± 300 volts, 0 to 50 mA d.c. from terminals with a common centre tap not connected to the chassis, and 6·3 volts from each of the two sets of a.c. terminals. The d.c. output can be operated with either the positive, negative or common terminal earthed as required. The two heater supplies are not stabilised and are floating.

The equipment draws 155VA at any frequency from 45 to 65 cycles and has a voltage selector for the range from 105 to 250 volts. The stabiliser is designed to accept up to ± 7 per cent variation without undue stress on the



heaters and will not lose control on variations up to 20 per cent. On the d.c. outputs the stabilisation factor is about 200 on the positive and 400 on the negative supply.

Output impedance is less than 1 ohm from d.c. (i.e. zero c/s) to 100 kc/s. The d.c. amplifiers use balanced stages and the ripple is 2 mV maximum. Two screwdriver adjustments are provided for the d.c. outputs. *Servomex Controls Limited, Crowborough, Sussex.*

CIRCULATING PUMP

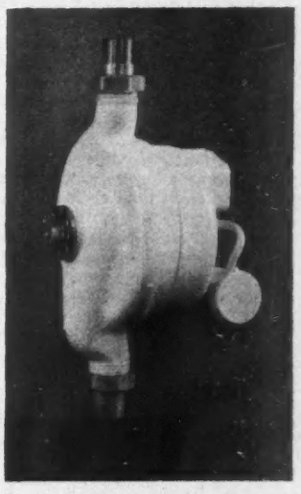
With Output Regulator

AN OUTPUT regulator on the two Radpump glandless circulators affords a coverage of from 4 to 8 ft head or from 9 to 13 gallons per minute at 1 ft head from the two models.

The pumps have sealed motors with resilient mountings so that the operation is almost silent, and the noise transmitted to the pipes and radiators, and so to the house, reduced.

The pump bodies are cast iron with the internal surfaces in contact with the water coated with high temperature stoving enamel. The impeller is diecast brass and has a self-lubricating bearing in its hub. The rotor is mounted on the back of the impeller and the whole rotates on a stainless steel shaft. The pump must be installed with the shaft in the horizontal position.

The terminal box has been designed for easy connection and the condenser is mounted on the motor body. Outside dimensions are 11½ in long by 6 in wide and 6 in deep. The standard units are for operation on 210-250 V single



phase or 400-440 V three-phase supplies. The rating is 75 W. *Sealed Motor Construction Company Limited, Bristol Road, Bridgwater, Somerset.*

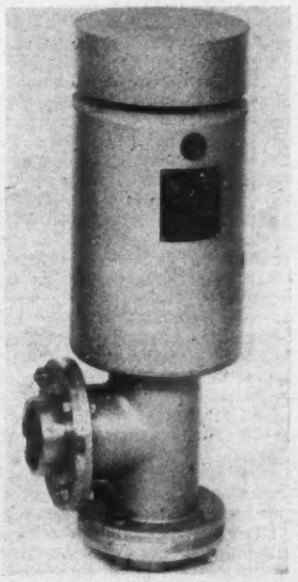
HIGH VACUUM VALVES

Magnetic Operation

AN IMPROVED range of magnetic valves for use in high vacuum installations offers a wide choice of features.

The valves are designed to operate against 15 lb per sq. in pressure difference across the seating which consists of a Nygon pad and a brass or stainless steel cone. The time of opening is dependent on the working conditions but generally is from ½ to 1 sec. Spring assisted closing takes less than 1 sec. Standard valves can be supplied either with integral contact-cooled rectifiers as illustrated for 200-250 volt a.c. supply, or for d.c. operation at 160 to 180 volts.

The standard ½ in and 1 in types may be mounted either way up, and horizontal operation can be arranged for any size. Changeover and make or break contacts can be fitted for interlocking. Valve sizes range from ½ in to 4 in nominal bore, and bodies can be supplied in brass or mild steel nickel plated or, alternatively, plated by the Kanigan process. *NGN Electrical Limited, Avenue Parade, Accrington, Lancashire.*



Ninth International Apprentices Contest

Under the eyes of Government and university representatives, some of the ablest apprentices in Europe have been contesting a competition which grows every year in company support.

FROM one man's determination, in the face of total lack of interest from British industry ten years ago, participation by United Kingdom firms in the International Apprentices Competition has grown to the point where at this year's ninth competition, just completed in Barcelona, the British were the largest visiting team.

The British 32 team members entered more of the competition categories than any other country except Spain.

The International Competition, enthusiastically supported by European Ministerial bodies, though not by the British Government, provides an up-to-date picture of the importance attached to industrial training over a wide cross-section of Europe, writes ENGINEERING's Industrial Editor who was in Barcelona for the competition.

From Germany, Belgium, Ireland, Italy, Portugal and Spain the official representatives were all government officials or government accredited. The official representative from Belgium is the administrative principal of the Ministry of the Middle Classes. The technical representative is the provincial secretary of the Vocational Training in East Flanders.

Mr. Frederick D. Hill, the secretary of the British organising committee for the competition, is a private businessman. Mr. Bill Skipworth, the technical representative, is an industrial training executive, generously lent by the Metal Box Company.

STRUGGLE FOR RECOGNITION

The story began with the entry of one British apprentice, Mr. Hill's son, in the joinery section in 1953. Up to the entry by apprentices, this year from the Marconi's Wireless Telegraph Company, Rolls-Royce, the Central Electricity Generating Board, and other distinguished, famous and not-so-well-known firms it is largely the story of one man's enthusiasm and refusal to be ignored.

Back in 1953 Mr. Hill had entered his son in one of the early International Vocational Training Competitions which had started three years before between the Spanish Youth organization and Mocidade Portuguesa, the Portuguese equivalent body.

The Spanish authorities revealed to Mr. Hill, almost at the last moment, that his son must have a guardian and Mr. Hill had no one he could readily turn to for help. Characteristically he went himself to the competition where, in addition to Portugal and Spain, entries had come from Switzerland, Germany, France, Morocco—and Mr. Hill's son, who later won a gold medal.

His interest in the International Competition strengthened by seeing it at first hand, Mr. Hill returned to Britain a strong advocate of the benefits to British industry of joining in. He sat down at his Canterbury, Kent, home and wrote letters to companies of all descriptions and sizes urging them to take an interest in the competition. The response was almost entirely negative, there were those who appeared to be wondering what Mr. Hills was "getting out of it," but also a handful who were willing to listen.

One of the first of his converts were the Metal Box Company who, for the last three years, have provided the British technical representative.

The competition was meanwhile receiving growing European support. By mid-1954, draft rules and regulations were being drawn up by a newly formed organising committee made up from all the interested countries. This committee is the governing body for the competition having an official and a technical representative from each country taking part.

Some of the slowness in catching on which the competition encountered in Britain was due to the belief in some minds that the contests were largely a Spanish affair.

When Mr. Hill met this opinion direct he countered with the reasonable proposal—"Well let us hold them in England." So far this prospect is no more than a distant hope. Next year's meeting is to be in Western Germany, at Duisberg. Both Portugal and Ireland have hopes for entertaining the competitors in 1962 and whoever is the loser will probably provide the venue in 1963.

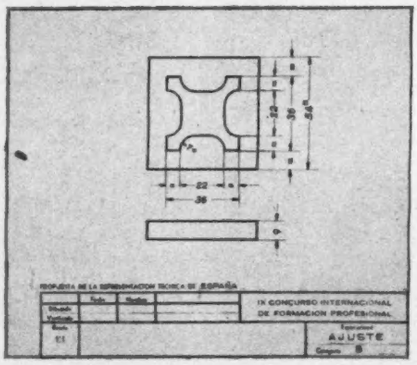
IN GERMANY NEXT YEAR

After that it may be that the competition will be sufficiently well recognised for official support to be provided by the British government and the competitors given facilities in the United Kingdom—especially when it is remembered that our keen competitors, the Germans, have played host to the assembled apprentices.

For this year's competition 173 apprentices arrived in Barcelona. The British contingent had been selected competitively from about 220 boys. The Spanish team of 37 were the final selection from many thousand young Spanish hopefuls. From Belgium there was a team of 20, and the Italian and West German teams were each 25 strong.

Housed in a hostel of the Escuela de Maestria Industrial, at Barcelona, the apprentices competed in their divisions separated into age categories. Category A, 96 strong, was for boys who became 19, 20 and 21 this year. Category B, 77, for 16, 17 and 18 year olds.

The trades in which the entries were made included fitting, turning, milling, wood pattern-making, oxy-acetylene welding, electric welding, sheet metal work, house wiring, stone cutting, brick laying, plumbing, house painting, silver



Fitting test piece, Class B.

smithing, jewelry, machine designing, draftsmanship, joinery, carpentry, radio fitting, foundry moulding, and a section for blacksmiths.

Not surprisingly, the British apprentices, like the Germans, coming from works provided with an abundance of equipment, found themselves at some disadvantage with, for instance, the Spanish or Portuguese competitors for whom improvisation is second nature. Behind the British or German worker there generally stands a well-filled spare parts store. The Spanish machinist will not necessarily have the same facilities on which to fall back. And this has its effect on what is expected of the apprentice and on the way in which he is trained.

A rather different, if parallel situation existed in the corner of the machine shop of the school where the sheet metal workers were forming petrol tanks for motor cycles. The apprentices were banging away on a deeply fissured wooden block. A Portuguese aiming at making his tank in one piece was even standing on his metal, working it on the floor. Back home, the Italians, the Germans and the English boys told me, there would have been sandbags and smooth-surfaced blocks

In other sectors of the test, covering milling, fitting, and turning, estimates of the machines in use in the Escuela de Maestria were in line with those of the Central Electricity Generating Board apprentice, who told me "I am very happy with the equipment and the conditions of the competition."

Beginning on Monday, 26 September, with an official opening, the apprentices went from the assembly hall to the workshops, balloted for machines and were given material and the drawings for the test. The first work period was for four hours until 7 p.m. On the Tuesday, Wednesday, Thursday and Friday the work periods were from 9 a.m. to 1 p.m. and from 3 to 7 p.m. On the final Saturday the work pieces were handed in at 1 p.m., at the conclusion of the final four-hour work session.

In the negotiations and arrangements preceding the competitions, the position of the British apprentices, accustomed to working in the United Kingdom's measuring system, was pointed out. In order to get over this the organisers provided suitable conversions.

The proportion of marks allotted for accuracy, finish, and use of materials varied between the trades.

The marking system for fitting was as shown:

Fitting

	Class A	Class B
Principal measurements	20	25
Secondary measurements	5	10
General finish	15	15
Fitting of pieces	55	45
Good use of materials	5	5
	100	100

Each of the competiting apprentices was handed a copy of the marking system for this particular section when he first collected his materials and drawings.

In electric welding the marking system was as shown:

Electric Welding Class B

Penetration	25
Cleanness of edges	10
Start and finish of the run	10
Union of runs	10
Porosity and scale	10
Visual appearance	25
Good use of material	10
	100

In Electric Welding Class A the time allowed was 18 hours and in Class B 6 hours.

Immediately after the completion of the working part of the competition all the official representatives, observers, competitors and helpers moved off to the ancient coastal city of Tarragona. This was the start of a "cultural tour" which was not the least of the rewards for the apprentices.

What benefit does a firm and its apprentices derive from entering for the competition?

There is a clear encouragement to the apprentices since, at the least, qualifying for entry brings a free foreign trip and tour in the host country. Putting it a little higher, there is the satisfaction for the apprentice of his work being successful in carrying him along a toughly competitive road. The increased spirit of competition set up in the qualifying process is obviously worth encouraging by companies.

At a time when workmanship and finish is an important factor bearing upon the success of competing industries, the importance to a much wider range of British industry than that so far represented is difficult to exaggerate.

Human Element

A Way Out of the Rail Deadlock

OPENING the British Transport Commission's Electrification Conference earlier this week, Sir Brian Robertson, the BTC chairman, observed that in many lands there was a certain camaraderie between the operating staffs of the railway systems. Evidently the camaraderie on the British Railways is not such that the increases received by the bulk of the railwaymen after the Guillebaud Report are going to be conceded to the men in the workshops without a determined struggle to keep them as small as possible.

Earlier this year it was announced that railway revenues were beginning to pick up. In the case of freight revenue the small but promising improvement was the first sign of recovery after many years of steady, depressing decline. There is a real prospect that with the improving services of the modernisation scheme the long promised trend towards breaking even is setting in.

The British Railways have brought into use more flexible charging methods that are highly spoken of. They have some services well worth making a song about. But none of this can stand up against a loss of public confidence.

The centre of the trouble over the 110,000 railway shopmen are the 88,000 skilled men. The gap between the National Union of Railwaymen and the Commission for these men, many of whom would have no difficulty in taking jobs elsewhere, is as little as 4*s* 6*d* a week.

Sir Brian wrote to the NUR secretary expressing his fears that irreparable damage would be done to British Railways by a strike. Mr. Greene shares his apprehension. But there is no reason to suppose that it is possible, or proper, to run a railway in times of full employment on below level rates. The voices of common sense were strongly supported by the executives of the Confederation of Shipbuilding and Engineering Unions who led the way to re-opening BTC-NUR talks on the claim.

If the railways cannot keep their shopmen then serious damage will be done to the modernisation scheme, just when the results of providing railway equipment of which the country may be justly proud are coming into view up the line.

University Scholarships without Means Tests

Sixty-one scholarships tenable at universities in the United Kingdom are being offered by the Electricity Supply industry in the next few months.

There is no means test and the scholarships are worth up to £1,350 over the period for which they are held. Grammar and public schools have been sent details of the awards.

Thirty-six of the scholarships, all for intending electrical engineers, are offered by the twelve area Electricity Boards, and 25 by the Central Electricity Generating Board, who have a broad requirement for engineers and scientists.

The scheme is open to both boys and girls, between 17 and 21, and each scholarship holder who successfully completes his university course is guaranteed a post in the industry. Since starting the scheme two years ago 96 scholarship awards have been made.

Death Throes or Re-Birth of the Labour Party?

A foreign observer intent on finding out what the British Government were doing, and wishing to avoid the utterances of the spokesman and the mouthpieces, might understandably decide to attend the annual conference of the Opposition party. At Scarborough, the unversed overseas visitor might think, he would hear the exposing voice of criticism, would really hear what the shortcomings were.

In fact he would have to listen diligently to detect the word Conservative in the corridors and lobbies at all. And when he did it would probably be in connection with rents, an important and pressing subject, but not one by which the country's fate stands or falls.

It is this widening gap between what the Government is doing and what the Labour Party is talking about that is the measure of the cost to a two-party democracy when its Opposition falls into a neurotic phase of all but total absorption with its personal state of health.

One-party government is anathema to the Westminster parliamentary tradition. Where it appears in newly independent states that turn away from what is understood as democracy there are genuine expressions of regret in the land of Gladstone and Sir Winston Churchill. Yet at home, such has been the degree of confusion, that while the gap between the capacities of the Forces and what they might be expected to be called on to do has perhaps never been wider, the focus of attention is not on national defence, but on Mr. Gaitskell's defence of his position.

Since the Government is not questioning Britain's place in NATO, and since the United States defence policies continue substantially unchanged, it is reasonable to suppose that the Labour leadership could have found time for a rousing performance on the present decline in exports leaving defence for another occasion. This too has been missing.

It could be argued that the latest figures have appeared while the House is in recess. A poor argument since a telling speech demands, and usually gets, an answer. The British part in the United Nations, in swiftly changing Africa and, at home, crucial subjects like general education and industrial training, are as good as forsaken in the interest of concentrating upon the interior battle.

It may well be that three electoral defeats in a row had to bring on a crisis over the Labour Party leadership. And whatever Dr. Johnson said about the death sentence clearing the mind, such a background is not likely to produce stimulating original thought. But if a party has to go so far towards tearing itself apart in the process of discovering a leadership less unlucky at the polls it raises the question of its ability to cope with the fast changing complexities of modern administration at all.

Rescue Apparatus Tests and Aluminium Honeycomb

For the rescue worker making his way through an explosion wrecked pit the first essential after the efficient working of his breathing apparatus is that he should be able to see out of the mask.

In meeting this need there has been trend away from the two separate eyepieces towards a single, fairly large, transparent sheet. On the face of it this appears to be entirely beneficial.

But laboratory tests, described in the annual report of the Safety in Mines Research Establishment, have shown that there is a significant, though not insuperable, effect upon the length of time for which the apparatus can be used.

The substitution of one transparent sheet for the two eyepieces generally produces an increase in the volume of air between the mask and the face. This means an increase in the amount of exhaled air rebreathed and of the proportion of carbon dioxide inhaled.

This has two ill effects, one is the bodily effect of taking in more carbon dioxide, the second is that simply by taking in more carbon dioxide the volume of air breathed per minute is increased. For certain types of mask, so the laboratory experiments discovered, this reduction in time over which it can usefully be worn is serious.

There is a way out of the difficulty without sacrificing the advantages of the wider-view one-piece transparent sheet. First it has been found that the proportion of exhaled air breathed in again depends almost entirely on the volume of each breath. The deeper the breathing the smaller the amount rebreathed. A considerable improvement in masks with a large " dead space " can be made by fitting a suitably designed mask over nose and mouth.

Binding Coal Dust

A new process for binding coal dust has been given further limited pit trials. This is the discharge of an aerosol of water with a binding agent into the mine ventilation current. Since this technique needs droplets with a mean diameter not greater than 25 microns, which normally evaporate within a few seconds, some means has to be found of slowing up the evaporation.

Pit trials have confirmed laboratory experiments which pointed to the effectiveness of emulsifying cetyl alcohol in the water. The trials have not yet been carried out on a large enough scale to show how far from the spray nozzles the droplets would be carried in roadways with conditions substantially differing from those of the trials.

Rigorous precautions at the pithead are carried out to avoid the overwinding of cages moving up and down the shaft but the problem of accidental overwinding remains. On drum winders the ascending cage which is overwound will become detached from the rope and lose its acceleration under the effect of gravity. But the descending cage needs stopping, and not so quickly as to harm the occupants. Both the ascending and descending cages with friction winders have to be arrested.

It is important that the performance of arresters should be predictable within close limits. Not all arresters now in use in the United Kingdom can be said to qualify.

The new style of arrester developed at the Safety in Mines Research Establishment makes use of an aluminium honeycomb. For the tests a ½ ton cage fell freely between two vertical rails, each rail passing through a pair of rollers on the side of the cage. At the bottom of the free fall the rollers came into contact with two long strips of honeycomb bonded to the rails. Moving downwards the cage squeezed the honeycomb strips to a quarter of their original thickness, meeting a constant drag which eventually brought the cage to a halt. The tests showed that once the deceleration force was built up it remained constant and was not dependent on cage velocity and travel.

DSIR on the Shortage of Scientists

The grave disquiet expressed by the Civil Service Commissioners at the lack of scientists in the Government service has been commented on by the Department of Scientific and Industrial Research. Agreeing that there is an overall shortage of scientists the Department has found that, in some fields, effort has expanded so swiftly and so much specialised experience is called for that the supply of " high grade " scientists has been left well behind.

Four particular cases within the work of the DSIR are the Road Research Laboratory, the ship hydrodynamics laboratory of the National Physical Laboratory, the National Chemical Laboratory and the noise research section of the NPL.

In road research the DSIR has found that the expanding programme is creating difficulties in the filling of all the new posts. It is felt that traffic engineering is not a subject properly appreciated by undergraduates. On this point it is perhaps permissible to wonder whether the student is likely to be seen improving the flow of traffic as a way in which to spend his life.

The ship laboratory of the NPL is meeting difficulty in recruiting naval architects and scientists. There is just not a sufficient output of naval architects to fill the available posts and the work of the laboratory is described as being gravely hampered. This shortage of naval architects is not confined to the laboratory. There are not as many of them as shipbuilding would like.

At the National Chemical Laboratory, where the work has been rearranged under a new director, it is hoped that the problems of finding scientific staff with the required qualifications and special experience will be solved as the new arrangements settle down.

It is well enough known that there are fashions in what graduates will take up: currently there appears not to be any enthusiasm to undertake courses of classical science.

Evidently the field of noise research is also out of favour. Staff of the appropriate standard is hard to find and it is the DSIR's experience that teaching on the subject is not often extended to the universities' third year.

At the same time that the whole subject of noise is increasingly accepted as an urgent problem, the research work of the NPL is being seriously held back simply because of lack of scientists interested enough to take up the work.

Computers Make Sense on Scale of Two

Basic to digital computing is the binary code, or scale of two, a knowledge of which may lead to a better understanding of computer programming and hence to better exploitation of computers.

By David S. Evans, M.I.E.E.

Hilger and Watts Limited

TODAY computing techniques and logic are so well established that they tend to be taken for granted and are probably only explained to trainee computer programmers and students attending specialised classes. The average instrument engineer picks up the jargon as he goes along and is content to absorb only what is necessary to cover the particular facet with which he is concerned. It is as well to reflect occasionally on the basic principles involved to see what sense they make. The scale of two, or binary code, is fundamental to these principles.

Modern day industrial, research and defence programmes are likely to call for a digital control or logging system often involving a computer. The data derived at source has to be collected and reduced to suitable form for the computer to absorb, after which it may be fed back to complete a servo control loop or it may be presented in a form suitable for the human operator to comprehend.

ECONOMICAL STORAGE

Most high-speed computers perform their arithmetic in the scale of two rather than the decimal scale because it is basically simpler and more economical in the number of logical elements required.

This economy becomes apparent if one considers, say, storage alone, since in an on-off system each figure or digit must have its own storage element, whether it be relay, flip-flop (bi-stable valve or transistor circuit), magnetic core or space on a magnetic drum. To store a figure between 000 and 999 in a decimal arrangement will require 30 elements, ten for each decade labelled 0 to 9. In a binary notation (discussed below) this can be achieved with only ten elements and at one-third the cost. In fact, the ratio becomes larger as the figures increase so there can be a considerable saving in space and power requirements as well as cost of the equipment.

It is an "on-off" system involving only two figures which are normally presented as 0 and 1. The only rules that are required for addition are as follows:

$0 + 0 = 0$
$0 + 1 = 1$
$1 + 1 = 0$ and carry 1
$1 + 1 +$ the carried $1 = 1$ and carry 1 so that:—

(1)	(2)	(3)	(4)	(5)	(6)
0	0	1	1	1	011
0	1	0	1	1	011
0	1	1	10	11	110

In the decimal system where we have ten characters to use, $1 + 1$ would be written as 2 and $1 + 1 + 1$ as 3. In the binary system this 2 is written as 10 and 3 as 11. The first (right hand) 1 is worth 1 or 2^0 and the second 1 is worth 2 or 2^1.

Extending this procedure the column values will be seen to double,

Power of 2	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Decimal value	64	32	16	8	4	2	1

A binary number written 1001011 has a value $2^6 + 2^3 + 2^1 + 2^0$ or $64 + 8 + 2 + 1 = 75$.

A table of numbers progressing from 0 upwards starts as follows:—

Decimal Number	Conversion	Binary Number 2^3 2^2 2^1 2^0
0		0 0 0 0
1	2^0	0 0 0 1
2	2^1	0 0 1 0
3	$2^1 + 2^0$	0 0 1 1
4	2^2	0 1 0 0
5	$2^2 + 2^0$	0 1 0 1
6	$2^2 + 2^1$	0 1 1 0
7	$2^2 + 2^1 + 2^0$	0 1 1 1
8	2^3	1 0 0 0
9	$2^3 + 2^0$	1 0 0 1
10	$2^3 + 2^1$	1 0 1 0
11	$2^3 + 2^1 + 2^0$	1 0 1 1
12	$2^3 + 2^2$	1 1 0 0

It can be seen that binary numbers get very long compared with their decimal equivalents.

The rules for normal subtraction are not unlike those for addition, except for the fact that instead of carrying, borrowing has to be done (as in any arithmetic) when the digit being subtracted is larger than that from which it is being taken so that:

$0 - 0 = 0$
$1 - 0 = 1$
$1 - 1 = 0$
$0 - 1 = 1$ and borrow 1

Although the process for subtraction is simple both in theory and practice it is interesting to note that many computers avoid doing it and arrive at the same solutions by adding the complement or reversal of the subtrahend plus 1. This is simplicity itself since to complement a binary number merely means to exchange 0s for 1s and 1s for 0s.

MULTIPLICATION AND DIVISION

Multiplication is usually performed by successive addition in order to avoid remembering multiplication tables. It is the same as saying in decimal terms $3 \times 7 = 7 + 7 + 7$. But short cuts may be taken by the use of a floating binary point, since shifting this one place to the right is equivalent to multiplying by 2 and 2 places by 4 etc. Displacement to the left is equivalent to dividing by 2, 4, 8, 16 and so on.

Division is effectively performed by successive subtraction. In decimal terms $9 - 3$ would work out as follows:

$9 - 3 = 6$ (once)
$6 - 3 = 3$ (twice)
$3 - 3 = 0$ (thrice)

so that 3 goes into 9 three times. Subtraction is complete when the balance is reduced to zero or below. When complementing however, the process of additions continue until the register has overflowed.

Fundamentally then, a computer can perform the basic functions entirely by addition taking one or two simple measures to reduce the operating time to a minimum. Here is where an intelligent programmer can save computer time.

BINARY CODED DECIMAL

While the computer may function in the scale of two quite happily the input and output data may be subject to human intervention. Usually the output of a data-handling scheme ends up in print and the computer has to translate from binary to decimal form.

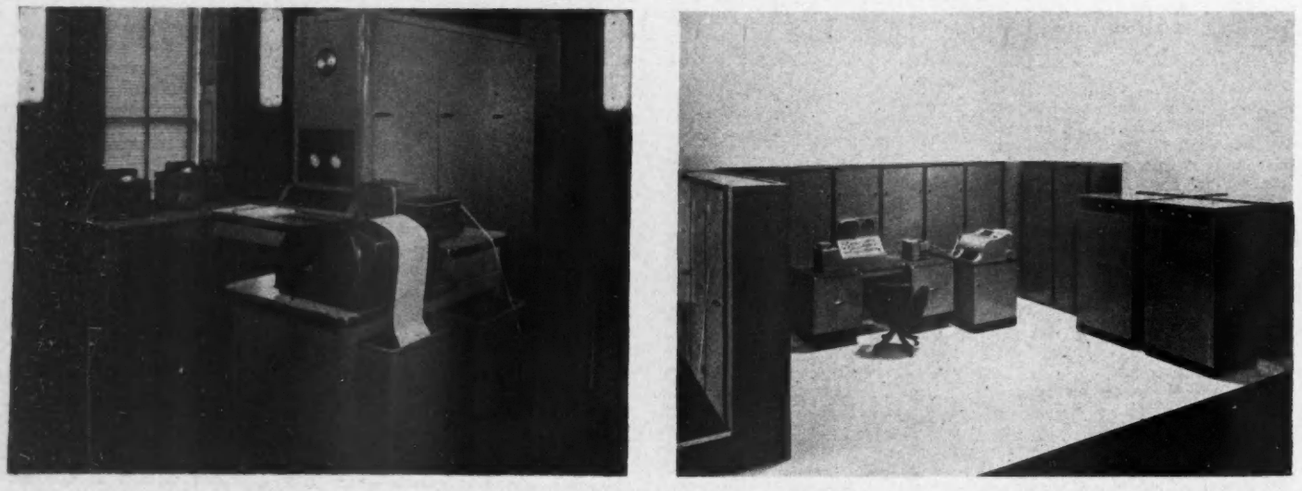
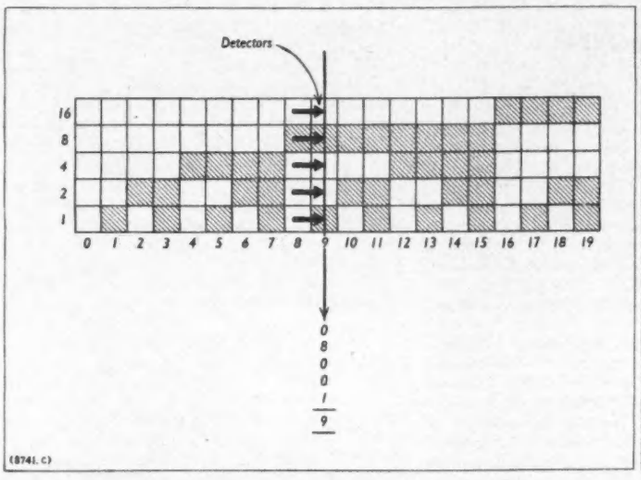


Fig. 1 Two Ferranti digital computers operating on the binary system, or scale of two, with associated equipment: (left) Pegasus, (right) Mercury.



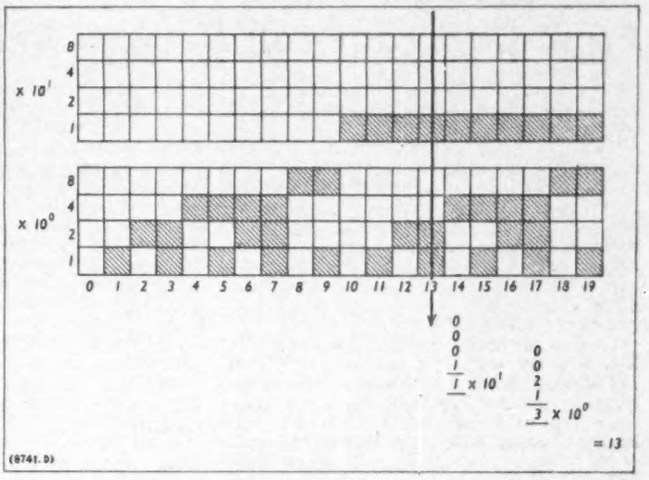


Fig. 2 (Above left) Pure binary scale.

Fig. 3 (Above right) Binary coded decimal scale.

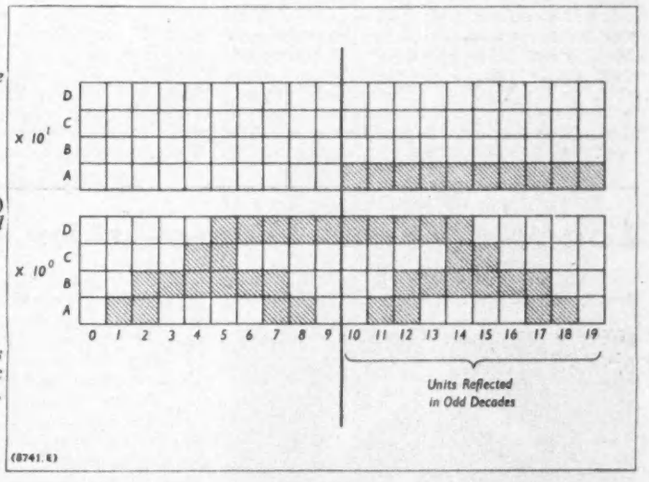


Fig. 4 (Right) Watts reflected decimal or cyclic permuted decimal scale.

The input to a computer is often taken from punched tape or card or magnetic tape. The information on the tapes or cards may be derived from manual decimal keyboards or digital transducers. Since it is sometimes useful and necessary to have a visual check on the input data at source it is not usual to record in the scale of 2. For ease of translation a compromise is made and a binary coded decimal (BCD) arrangement used.

CHECK BY TRANSLATOR

Since four binary digits (normally abbreviated to "bits") will give 16 combinations, it is possible to represent the figures 0 to 9 by a combination of these four bits (six combinations being redundant). In other words the decimal breakdown of hundreds, tens, and units is preserved and each decade is separately coded. Effectively, a simple translator, which will accept four bits and convert these to decimal, is all that is required for check purposes. But it does mean that the computer has some additional work to do in translating from the BCD to pure binary before it can compute.

A hole in a punched paper tape or card represents the figure 1 in a binary system. There are three or four recognised codes in everyday use where an extra hole or two has been added to each row to provide checking facilities, instructions and letters of the alphabet, the most common of which are the International Teleprinter, Decca and Ferranti Codes.

In industrial control systems manual punching of tapes, cards, etc., is too slow and automatic means have to be found to convert physical changes such as temperatures, pressures and machine movements (analogues) to digital form for recording, display and subsequent computation. Such devices are called digital encoders or digitisers, the most common of which convert either mechanical movements or voltages to coded electrical signals. The pitfalls are common and the basic idea is most easily explained by considering the use of scales used in shaft digitisers.

PURE BINARY SCALE

A pure binary scale is shown in Fig. 2, where the dark segments represent the figure "1" and can be considered as conductive, while the light portions are "0's" and non-conductive.

The scale is divided uniformly along its length, each section being numbered in code consecutively from 0 upwards. The value of the digit "1" in each track or horizontal row is indicated on the left, and is a power of two arranged in ascending values from bottom to top. The value of the division marked by the arrow is determined by the sum of the digits in the scale of two and corresponds with the decimal value given below.

In order to pick this reading up electrically, it must be assumed that there is a row of contacts resting on the scale as shown. Where the current passes, the contact is on a conducting sector; this sector is called "1." If such a scale is made in circular form and attached to a shaft, the shaft position, which may be a leadscrew rotation on a machine, can be read off and transmitted electrically continuously or intermittantly.

When decimal answers are required the equivalent scale is labelled in BCD, as indicated in Fig. 3, each decade comprising four separate digits.

Because the decades are preserved it is much easier to translate to decimal than the pure binary form. A simple decoder will accept four binary digits and convert them to decimal 0 to 9. Each decade is the same, so the circuits are no more complicated for several decades than they are for one.

While the scales described are in use, precautions have to be taken to avoid errors in reading due to ambiguities at the transitions between numbers. For example, the change on each scale between 7 and 8 requires a change of all four digits. If these do not occur simultaneously when the scale is moved from one number to the other any combination of digits may occur at the boundary.

CHOOSING

Two methods are used to overcome this trouble, one is known as a "choosing" system where the detectors are duplicated and spaced apart and are referred to as "leading" and "lagging" detectors. It is possible by avoiding reading from the detectors near or on a boundary to avoid ambiguities of the type described. The second method is to rearrange the code pattern so that there is never more than one digit change at any time.

The permutations that provide this result serve to produce a cyclic or reflected type pattern. The equivalent binary arrangement is called cyclic permuted binary (CPB). There are several possible permutations however for the BCD type scale since only ten out of sixteen combinations of four digits are used. The Watts reflected decimal (WRD) is an example and is illustrated in Fig. 4.

It can be seen that in each of the cyclic scale arrangements there is only one digit or track change at any one time along its length. Indecision on the transition means that the point of changeover of two adjacent figures is being determined and the answers will differ by one least significant digit only. Since in any system such a decision has to be made sometime, no significant error is introduced.

DECODING CYCLIC SCALES

The decoding of cyclic scales is slightly more complicated than with the "straight" scales, since the digits cannot be given numerical values and translation has to start from the top or "most significant" digit downwards. This additional complication is often more than offset by the fact that only one set of detectors is needed, so simplifying the construction of the digitiser.

In coarse and fine geared systems backlash between two scales serves to produce further possible ambiguities and can be overcome by duplicating detectors on the coarse scale in "lead" and "lag" arrangement, the choice of reading being determined by the finest scale. Therefore the choosing system is normally used.

It will be appreciated that the contact-type scale has been given as example only and other types exist in practice using photoelectric and magnetic techniques.

First Contract for Severn Bridge

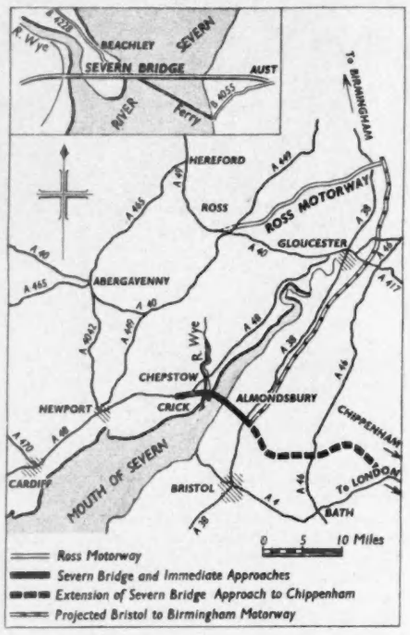
The expected announcement that work is to start on the Severn suspension bridge was made last week with the invitation to tender for the construction of the foundations and sub-structure of the bridge and of access roads to the site. The timing of the project is being phased with the construction of the Forth bridge, so that fabrication facilities and erection gear, particularly for spinning the main suspension cables, may be transferred from one job to the other. Completion of the whole project, including the adjacent bridge over the Wye and associated motorways, is to be in 1965-6 and the cost £16 million.

Crossing the Severn between Aust and Beachley, the bridge will have a main span of 3,240 ft and is expected to be the fifth longest in the world, following Golden Gate (4,200 ft) in San Francisco, George Washington (3,500 ft and now having a second deck installed) and Mackinac (3,800 ft) both in New York, and the new Forth bridge (3,300 ft).

The first contract covers the two piers for the main towers, the anchorages for the cables, and the approach viaduct and access roads on the Aust (east) side. Hollow precast concrete blocks will be used for both the main pier and the anchorage on the east side, where construction will be sited on the tidal foreshore of the river. Work will proceed at low tide and the blocks, joined by steel reinforcement, will be filled with *in situ* concrete. In plan the pier will be 140 ft by 42 ft, and it will be 63 ft high; the anchorage will be a pair of massive blocks 145 ft long, 40 ft wide by 120 ft high, separated by an enclosed space and each containing galleries and chambers. The western pier will be similar to the eastern, but will be supported on caissons sunk into the river bed to firm rock. The west anchorage will be the same as the east except that it will be sited on dry land. The east approach will comprise a viaduct of three spans each of 170 ft.

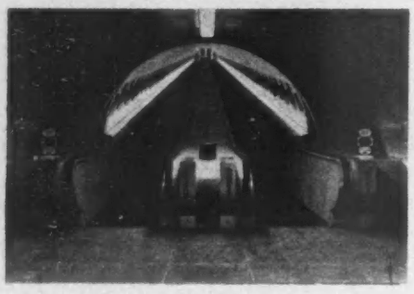
As at the Forth bridge, steel towers will support the main bridge and they will be 470 ft high. In addition to the main span of 3,240 ft, the two side spans will each be 1,000 ft long and the road level will be 130 ft above high water of ordinary tides at the piers and 150 ft at mid-span. Under the worst combination of temperature, loading and tide, the minimum clearance for navigation will be 120 ft. Between parapets, the bridge will have a width of 118 ft, including two carriageways of 24 ft.

The consulting engineers for the project are Mott, Hay and Anderson in association with Freeman, Fox and Partners. Sir Percy Thomas is the consulting architect and the design is before the Royal Fine Art Commission.



London's First Trav-o-lators Begin Operation

The first permanent "moving pavements" in Britain are the twin Trav-o-lators linking the Southern Region's Waterloo and City line with the higher level circulating area and Bank underground station. Based on the standard Otis escalator used by London Transport Executive, the Trav-o-lators have a maximum speed of 180 ft per minute and can carry 10,000 people an hour up their installed incline of 1 in 7.



To accommodate the Trav-o-lators a 16 ft 6 in diameter tunnel was driven with larger diameters for the return machinery and a passenger circulating area. At the upper end, the machine chamber and booking hall is approximately 100 ft long, 35 ft wide and 30 ft deep. The total rise is 42 ft in an inclined length of nearly 297 ft and the overall length, including the top and landings, is 302 ft 6 in.

Each Trav-o-lator strip comprises 488 steel platforms 40 in side by 16 in long. Each platform, for which the assumed loading is 300 lb, rides on four ball bearings of phenolic and canvas that run on tracks forming the contour of the Trav-o-lator and designed to confine side movements within narrow limits. The platforms are driven by a pair of roller chains and power for each strip is provided by a variable speed 85 h.p. motor.

The consulting engineers for the work have been Mott, Hay and Anderson and the contractors for the tunnelling and general engineering, Mitchell Brothers, Sons and Company Limited of London, SW1. The contractor supplying and installing the Tav-o-lators were the Otis Elevator Company; electrical installations were by AEI (Rugby) Limited.

Metropolitan Water Board's 19 Mile Pressure Main

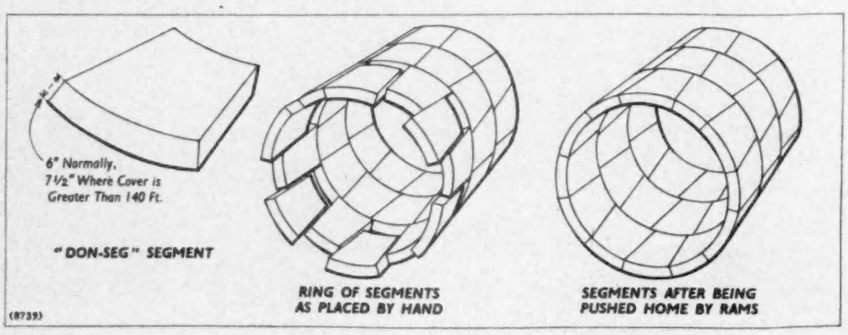
Last week saw the inauguration of the Metropolitan Water Board's raw water main that has been built below London to convey water from the Thames reservoirs on the west side to the Lee Valley reservoirs on the east side. It will serve to eliminate the risk of serious water shortages in East London following a dry spell and will also enable the capacity of the works in the Lee Valley to be increased and maintained at an economic level of output. Hitherto it has been the practice to pump large quantities of treated water across London whenever there was a deficiency in the Lee. The main has a designed capacity of 120 million gallons a day.

For the greater part of its length of 19 miles the main has an internal diameter of 102 in and has been constructed at such a depth that the water from the Thames flows by gravity to a terminal shaft where the water is raised by pumps and distributed to local reservoirs.

To line the main, concrete segments of one of two types have been used; the Don-Seg, which is illustrated, and the Wedge Block, developed from the Don-Seg by the MWB. In the former there are twelve segments to a ring, all of which are wedge shaped and interchangeable; the ring is forced home by the driving rams of the tunnel shield. In the wedge block system, only the crown segment is a true wedge and, apart from the faces mating with "key," all the joints are parallel. In neither system are the segments reinforced, nor are bolts required to hold them together. In practice some grouting behind the lining is required where the ground is not good.

Generally the main follows the most direct route between the terminals and is at such a depth, about 100 ft, as just to remain within the London clay.

The main contractors for the tunnelling have been Kinnear, Moodie and Company Limited, who worked from a series of shafts sunk at intervals of ¼ to 1 mile and who developed the shield required for the work. Tunnelling was begun in February, 1955, and completed in June, 1959; in good ground, the rate of work reached 360 ft in a week. The final operation was to line the tunnel with a ½ in thickness of mortar to improve the flow. The consulting engineers for the work were Sir William Halcrow and Partners of London.


6" Normally.
7½" Where Cover is Greater Than 140 Ft.
"DON-SEG" SEGMENT
RING OF SEGMENTS AS PLACED BY HAND
SEGMENTS AFTER BEING PUSHED HOME BY RAMS
(8739)

Joining Steel Beams and Concrete Columns

A combination of steel and precast concrete members will, under certain conditions, form an economical and easily erected building frame. Precast concrete columns are frequently cheaper than steel, particularly if they have to be designed to take lateral as well as vertical loads. Steel, on the other hand, can be more suitable for long span beams.

Making good joints with such an arrangement is not difficult, even if there is a need to provide a high degree of fixity at the joint, and the design problem is considerably easier than that of obtaining an economical joint between two precast members.

The above points are well made in an article entitled "Joints in Precast Concrete Building Frames," by Mr. E. M. Rensaa, M.E.I.C., which appears in *The Engineering Journal* of the Engineering Institute of Canada for August. In the article the author discusses the general problem of making joints in precast members, drawing attention to European, especially Russian, experience. In making his points. Mr. Rensaa, a partner in Rensaa and Minsos, Architects and Consulting Engineers of Edmonton, emphasises the basic differences in construction economics between North America and Europe due to the much higher cost of labour there. For this reason, the Canadians and Americans much prefer to use materials rather than labour.

The article concludes by considering possible developments in jointing precast members and the opinion is expressed that much will depend on the increased use of welding reinforcing bars. At the moment, welding reinforcement to take tension is rarely practised in the Americas. Little is known of the problems of welding high carbon steels so that making a butt joint, under normal site conditions, can be somewhat risky. Undesirable as the lap splice may be, in many respects it is still, in the author's opinion, the most reliable form for a splice.

ASTM State 25 Soil Problems

At the annual meeting of the American Society for Testing Materials, the research sub-committee responsible for soils for engineering purposes, under the direction of Professor W. S. Housel listed 25 problems on the committee's study programme. Such fundamental matters as the physical-chemical properties and the dynamic characteristics of soils are included on the list.

In the field of soil investigations and sampling the committee is taking advantage of work accomplished by other organisations, such as the Canadian Standards Association, which has prepared a method of performing cone penetration tests, and the United States Bureau of Reclamation, which has perfected a method for vane shear testing of soils. These two methods are being reviewed for possible incorporation into existing or new ASTM standards.

Methods of test for determining the maximum and minimum density of granular soils are being developed. Capillarity and permeability of soils are being given attention, with a research project established to secure the necessary technical data for a method of test.

The well-known California bearing ratio test for soils will now be recognised as an ASTM standard and, in this same field, a proposed method of test for density of soil in place by the rubber balloon method has also been approved.

Renewed interest was noted in a bearing test of soil-in-place and several items were discussed for future study relating to plate loading tests. For pile load bearing tests, a proposed method for the load capacity of batter pile frames, submitted originally by the US Bureau of Yards and Docks, was approved in substance. Additional research problems relating to pile tests include stress conditioning and pile deformation under load, load distribution in side shear and point bearing, stress distribution in the soil mass surrounding a pile, and bearing capacity and action of piles under shock loading.

The committee is planning a symposium on the dynamic properties of soils as well as a general soils session for the 1961 annual meeting.

Computer Programme Library

The Institution of Civil Engineers have established a library of computer programmes covering the civil and structural fields. The setting up of the library followed suggestions put forward earlier this year during the discussions on the paper "The Place of Digital Computers in Civil Engineering."

The use of computers in structural design has been growing rapidly in the last three years and a number of the consultants have made use of the services provided by the computer manufacturers or of the computers available at universities such as Southampton and Manchester, or at the Northampton College of Advanced Technology. The United Steel Companies also have a computer available and have devised programmes to speed the design of steel framed buildings.

A library of civil engineering programmes compiled by the Cement and Concrete Association has been in existence for nearly two years.

New Structural Steel in USA

The American Society for Testing Materials have approved a specification of a new structural steel, designated A 36-60 T, which has a minimum yield point of 36,000 lb per sq. in. The new steel, which has been quickly adopted by American industry, will supplement the A 7 and A 373 steels (yield points of 33,000 and 32,000 lb per sq. in respectively) already on the stocks. Though more expensive, the increased yield point more than offsets the increase in cost so that economy will result from its use. First reports suggest that the new steel will be in great demand.

In addition to the guaranteed minimum yield of 36,000 lb per sq. in, the A 36 steel will have an ultimate tensile strength of between 60,000 to 80,000 lb per sq. in. The maximum carbon content is specified as 0·28 per cent ladle and 0·32 per cent check analysis. Additional requirements for manganese content are imposed for plates or bars over ¾ in in thickness, and for plates over 1½ in thick the silicon is specified.

The revelant British Standard has not been revised since it was issued in 1941—High Tensile (Fusion Welding Quality) Structural Steel for Bridges etc., No. 968-1941. The carbon content was limited to 0·23 per cent and the yield point varied from 19 tons to 23 tons per sq. in (42,560 lb to 51,520 lb per sq. in) according to whether the steel was for plate or sections and on the thickness of the material. The ultimate strength varied from 33 tons to 43 tons per sq. in.

Copies of the specification may be obtained from ASTM, 19 Race Street, Philadelphia 3, Pa., at $0·50 per copy (minimum order $1·00).

Wind Station for Aluminium Building Unit

One of the first wind test stations of its kind is being used by the Reynolds Metals Company, Richmond, Virginia, USA, to test the effects of wind and rain of up to hurricane force on aluminium building components.

The station is equipped with a 1,200 h.p. aricraft engine to whip up wind speeds of 120 m.p.h. and with a water spray system able to simulate rainfalls of 20 in per hour. An observation window permits watchers to see how the components behave. The station is sited at Byrd Field, the airport at Richmond.

Volta Dam Contract Next April

The contract for the construction of the Volta River dam and the associated power station, expected to be worth around £60 million, will probably be awarded next April. The dam will be a rock-fill structure that will raise the level of the river by about 200 ft. The Ghana government, in inviting tenders, announced that is was planned to have a "pre-bid" meeting in Zurich in December, at which those who wished to tender would be able to get all the information that they required. It has already been announced that the Ghana government will make an *ex gratia* payment of £2,500 to a limited number of approved contractors who submit tenders but are not successful.

American Tyred Shovel on Road Work

One of the first of the new Caterpillar 944A wheeled Traxcavators to be brought into the United Kingdom by Fred Myers Limited has been sold to Cubitts Fitzpatrick Shand and is being used on the Doncaster by-pass motorway. The Traxcavator is fitted with rubber tyred wheels instead of the more usual tracks. In the photograph, the machine is shown loading a 22 ton

A Caterpillar wheeled Traxcavator at work on the Doncaster motorway.

Euclid dump truck near the site of one of the many railway bridges that cross the road. The reach of this new 2 cu. yd loading shovel may be judged from the photograph.

The Doncaster motorway, due for completion in June, 1961, is an 18 mile north-south route around the town; it has been designed by Colonel S. Maynard Lovell, M.I.C.E., Engineer and Surveyor for the West Riding County Council, who are acting as chief authority to the Ministry of Transport.

Flexibility of Pitch Fibre Pipes and Pipelines

The ability of pitch fibre pipes to bend, and thereby respond to ground movements without fracture, has been investigated in a series of tests made on behalf of the Pitch Fibre Pipe Association of Great Britain by Stanger Laboratories at Elstree.

Sample pipes made by each member firm of the association were used in the investigations. In the first series of tests, lengths of 5 ft 6 in were cut from 4 in diameter pipe, filled with water and set up in a 3,000 lb single lever testing machine to give a clear span of 4 ft between steel V blocks. The load was applied at the rate of 6·8 lb per minute at mid-span until failure occurred. Deflections varying between 1·42 in and 2·60 in were obtained just prior to failure, with an average value of 1·96 in.

To establish deflections at the joints, a second series of tests was carried out. The method of loading was similar to above, but the specimens were built up with a standard joint made by driving tapered ends into the usual collars. Loading was applied to the collar, located at mid-span, until the joint failed so that water leaked away. The joint deflections at failure ranged from 2·35 in to 5·90 in and averaged 4¾ in.

To recruit the best Foremen: Give them Status, Pay them More, Train them Better

A National College for Future Foremen?

Two questions recently put by ENGINEERING to senior managers on the problems of recruiting foremen have disclosed both genuine anxiety and constructive proposals.

WIDESPREAD difficulty throughout industry in finding suitable men to promote to foremen is indicated by the results of a survey conducted by ENGINEERING among firms of all styles and sizes in the engineering industries.

Over three hundred companies have so far contributed their experiences and suggestions for improving the supply of qualified and competent foremen. Of the first 300, the number of companies meeting increasing difficulty in appointing suitable men to be foremen is 157, or 52 per cent.

Three companies pointed out that finding the right men to become foremen had always been troublesome but they did not think it was any more of a problem now than in the past.

The remainder reported that they had no difficulties, or that they had taken a variety of steps to overcome past shortages of suitable men and these had been successful.

Among those reporting difficulties almost a third, 42, want to see more training given to future foremen, including full-time instruction in what a foreman is and what he should be doing. Greater authority and also closer association of the foreman with the management is suggested by 23 companies, 16 per cent of those with foreman problems.

The same number of companies describe the disparity between the foreman's extra responsibilities and any additional reward he may receive as a serious reason for men being unwilling to be promoted. A handful of this group complain that the foreman may end up earning less than the men he is to some extent controlling, but they are not unanimously in favour of increasing his earnings.

A small group of 12 firms is explicit about the need to give the foreman "perks." Two of these are in favour of foremen being able to use company cars or of having their own serviced by the firm. An extra week's holiday above that enjoyed by the rank and file employees is also suggested for its value in raising status.

Mr. W. G. Richardson, a director of Intermit, the Birmingham filter company, sums up the wages problem when he says: "It is difficult to find suitable men who will accept a job at £800, £900 or £1,000 a year, even if it is a job of staff status and privileges, when others, perhaps less intelligent, are earning £25, £27 and £35 a week with almost the same degree of security.

"It may be that we shall have to think again in terms of the level of salaries for good foremen. Salaries of up to £1,500 a year or more may have to be offered eventually in order to attract the right man."

Mr. Richardson is in favour of creating a National Foremen's College, which would give a six months' intensive course.

TOO HASTY PROMOTION

Seventeen companies complained that men were not willing to accept responsibility. References to the effect of National Service were not explained in detail; a more common reason given was that men who had served on the shop floor did not wish to be placed in authority over their recent colleagues. Some foremen who have been promoted in the works have had trouble with enforcing discipline.

The practice of promoting chargehands to foremen is criticised by Mr. A. W. Hill, works manager of Richard Sutcliffe, manufacturers of mechanical handling equipment. Foremen, says Mr. Hill, are supposed to be part of management but they are hardly ever treated as such.

"Vacancies are usually filled from the shop floor, often hurriedly, and usually from the position of chargehand, which is very different from the position of foreman. The answer is to train future foreman as one does other managerial grades and give them responsibility plus authority."

"No one firm can solve this problem," Mr. Hill argues, "so it must be done on a national basis by the setting up of suitable colleges for the training of young men specifically for the position. The only colleges known to us to be in existence at the present time are for the training of men already holding the position, who are usually unsuitable material."

From another internationally known firm the manager of the turbine works declares that the day has gone by when foremen could be promoted overnight. Recognising that the foreman problem exists in his firm and outside, the same manager links it with other "urgent manpower needs in industry," such as the recruitment of planners and work study engineers.

Proposing regional full-time residential courses organised either by employers' federations or by a Government agency, this manager declares himself in favour of courses lasting for four months and giving the essentials of foremanship, planning, and work study—covering at least the basic theoretical knowledge. This would have to be a full time course because of the poor response to evening classes—a comment with which few are likely to cross swords.

Another group of 17 companies would like to see foreman posts made a step on the road to management positions. There is some parallel here with the manner in which in the Soviet Union engineering graduates start work on the shop floor and also with the very much higher number of qualified engineers in supervisors' production jobs in the United States.

NEW TRADITION

Describing the method of providing foremen from the shop floor as "failing," the managing director of a Lancashire heavy engineering group says that consideration should be given to "establishing a tradition" for candidates for managerial posts to spend a period first as assistant foreman and later as foreman before expecting further promotion. This managing director did not think that the turnover in foreman positions would be a disadvantage.

Carefully thought out steps have been taken by Marshall, Sons and Company, at the Britannia Works, Gainsborough, Lincolnshire, to overcome recruitment problems. Difficulties in finding suitable men for promotion continue but Mr. F. Walker, the works general manager and a local director, thinks this is due to the increasingly high standard of foremanship now required.

The steps taken by Marshall's include making the status of foreman "attractive" in comparison with that of the workpeople. This includes a Foremen's Association, which has facilities for improving supervisory techniques.

A management library has been set up and it is available not only to foremen and salaried staff but to all the employees. It includes many books on foremanship and supervision. A course of "Training within Industry for Supervisors" has been introduced for potential foremen.

One of several references to the Engineering Industries' Group Apprenticeship scheme, in which apprentices may stay on the pay roll of their parent firm while being moved around selected firms gaining experience, was made by a small—170 employees—manufacturer of cycle accessories. The difficulty this firm is finding in promoting men to foremen is that of giving suitable men an adequate training.

Those managers who touched on the increasingly widespread entry to the universities were not inclined to see this as affecting the foreman position. University-level young men, said one, were not suitable, were of an "academic" style of mind and even without the chance of starting their careers with a degree would have been looking for management jobs and not production work.

From Lincoln comes support for the contention that all those who aspire to management in industry should first go through the shop floor and have foreman experience. Mr. J. R. Bergne-Coupland, assistant managing director of Ruston and Hornsby, comments that difficulties have been found in obtaining suitable men for promotion, but this difficulty has possibly existed for at least 20 years.

ENGINEERING'S Two Questions

1. Have you observed increasing difficulty in finding suitable men for promotion to foremen?
2. Have you any suggestions for overcoming this difficulty?

"One of the problems is always to try to find supervisors who have the required balance between technical training and training in logical clear thinking on the one hand and who have sufficient practical experience in the shops with suitable personalities for controlling labour and leading men on the other," writes the assistant managing director. "One of the major problems is to find people with both fundamental knowledge and the ability to think clearly and logically, and also to control labour."

The company has a number of suggestions. First is the creation of a public awareness of the importance and status of the foreman or supervisor. Then, since with production control, quality control, budget control, planning and work study, among other specialisations, the foreman seems to have lost some of his own power, it is necessary to get over the idea that the foreman is manager of his department and must also be paid the appropriate wages or salary.

A PRACTICAL ANSWER

Whether or not difficulty is found in finding suitable foremen is a question of how you set about the job. That is the view of Mr. C. J. O. Garrard, the deputy general manager of the General Electric Company's Erith engineering works. The scheme which has been evolved by the company bases its selection mainly upon character, while taking education and technical knowledge into account. The training course is run by the local College of Technology. It gives the usual business administration subjects at a level suitable for the proposed level of supervision. Discussion groups are used, conducted by men of practical experience. This produces a fairly regular supply of people suitable for promotion, most of whom are made foremen, and many of whom have gone on to greater responsibilities.

Mr. Garrard makes the significant point that it is important in a scheme of this sort to be able to place all, or almost all, of those trained, in the job for which they have been preparing. This is easier to do in a period of expansion.

From one executive came the stirring exhortation that industry would do well to get back to the Oxford dictionary's definition of the foreman. It is—*One who goes in front.* More specifically it is *The principal workman, one who has charge of a department of work.*

Critical Control

CONTROL of a reactor is as important as the trigger that initiates a nuclear bomb and if wrongly used can produce serious results, if not as devastating. Where reactivity is high and reactor period of the order of microseconds, the rate of fission and hence power level is capable of a very rapid and dangerous rise. Control depends on the effective reproduction constant (k_{eff}), since the reactor power level is nearly constant with the neutron flux. At the condition when the reactor is supercritical, the reproduction constant greater than unity and the power rising, accurate control becomes imperative.

Control Methods

Control of the effective multiplication constant or reactivity can be effected by four different methods, which involve movement of the fuel, moderator, reflector or neutron absorber. Each method or a combination of them has been or is being used for the control of reactors. But the most common method is to insert an absorbing material into the reactor core. This approach has its disadvantages because the material is assumed black to neutrons and any neutrons falling on to the material will be absorbed. In systems with high reactivity and a large power output this absorption can result in a considerable loss, although ideally during operation the absorbing material will be withdrawn from the reactor. In some cases it has been found possible to make the lower portion of the control rod from fissile material, so that on lowering the absorber into the core it also has the effect of removing some of the core, thereby bringing a further reduction in reactivity, and reducing the heat output. The use of absorbers leads to another effect: the absorbers take up room in the core, thereby increasing its size; and it is the aim of every designer to keep the reactor as small as possible for a given power level. The choice of absorber material must be given careful consideration due to the possible radiation effects it may undergo. Another approach is to use fissile material for the entire control member, removing it from the core in a converse manner to the insertion of absorbers. Table 1 lists some of the more common absorber materials, giving their cross-sections and absorption distances.

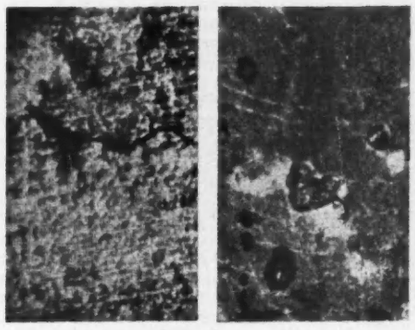


Fig. 1a (left) Boron 10 zirconium alloy irradiated to 40 per cent burnup of the boron 10 atoms.

Fig. 1b (right) Dispersed concentrations of boron produce "pimpling" or "warting".

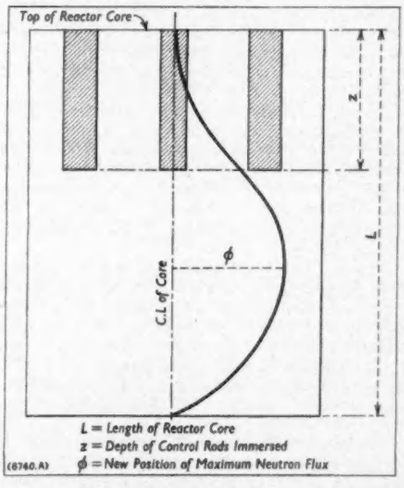


Fig. 2 Effect of partial insertion on the axial neutron distribution.

Requirements of Absorber Material

The best absorber is one whose cross-section for all energies is high, but those having sharp epithermal cut-offs with relatively high cross sections are often used. The absorbers are normally fabricated into plates or rods which must have good mechanical properties, resistance to attack by the environment, good mechanical and geometric stability, and good resistance to damage by whole-pile radiation. Low atomic mass and high density, giving a large number of absorbing nuclei per unit volume is of course the prime requirement. A material which reacts with neutrons by radioactive capture rather than fission or particle omission is preferable, since neutron-alpha reactions result in swelling, embrittlement, deformation and other undesirable effects. The ideal condition is to have an element which will produce a chain of neutron-born daughter isotopes of appreciable cross-section giving a chain of captures resulting from successive neutron-gamma reactions on the high cross-section atoms in the absorber.

Boron

The absorbing isotope, boron 10, comprises only 19 per cent of the naturally occuring element of boron. This deficiency means that it is necessary to enrich the absorber if it is to be used in high power reactors. The neutron bombardment produces the following change:

$$B^{10} + n \rightarrow Li^{7} + \alpha + 2\ MeV$$

Apart from the production of heat, which may be considerable, there is also considerable radiation damage caused by the neutron-alpha reaction, which brings about a 3 per cent volume change. Moreover the production of helium creates severe internal strains which can lead to cracking. It is normal to alloy boron and zirconium or steel are the other metals often used. If the burnup is in excess of 5 per cent considerable growth and embrittlement results; Fig. 1(*a*) shows the effects in a boron-zirconium alloy, after experiments by W. K. Anderson and D. N. Dunning. The experiments also demonstrated that if the boron is placed in dispersed concentrations in the alloying element the surface suffered from "pimpling" or "warting" as shown in Fig. 1(*b*). This indicates that a cladding material is necessary. In spite of its limitations, boron is being widely used for the control of present-day reactors.

Cadmium

This element is seldom employed by itself because of the low melting point 310° C (590° F). It has a high cross-section, and the cadmium 113 absorbing isotope is found in a concentration of 12·3 per cent. It has a sharp cut-off in the low epithermal region. It is often used alloyed with some other absorbing material.

TABLE 1:—*The macroscopic cross-section and absorption length of some absorber materials*

Material	Macroscopic Cross-section (cm^{-1})	Depth of absorption from the surface (cm)
Boron	96·6	0·03
Cadmium	112·0	0·03
Europium 151 ..	6·0	0·5
Iron	0·2	15·0
3 per cent Boron Steel	3·0	1·0

Hafnium

The chief advantage of this element is that it has a five member series of absorbing mother-daughter isotopes connected through neutron-gamma reactions. It has also good capture behaviour in the epithermal ranges, good resistance to radiation damage, and corrosion; but the thermal cross-section of all the absorbing isotopes is low and it has a high atomic mass in spite of a high density, which will lead to bulky rods or plates. The scarcity of the element makes it almost unavailable, and it has to be fabricated in a vacuum or inert atmosphere.

Europium

Europium is very plentiful in large ore deposits throughout the world. It has the important features of long endurance at high power densities and an impressive line of mother-daughter isotopes. The last of the series has a cross-section of 13,000 barns. Methods of fabrication include powder metallurgy, which is now well proven, and so far little trouble has occurred due to radiation damage.

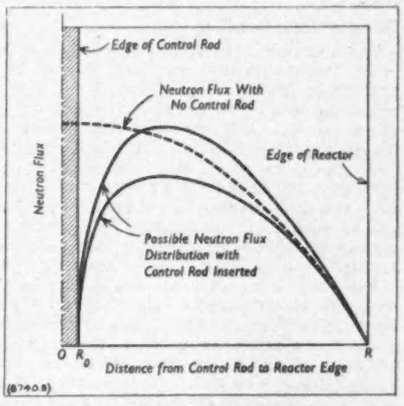


Fig. 3 Effect of control-rod insertion on the radial neutron flux distribution.

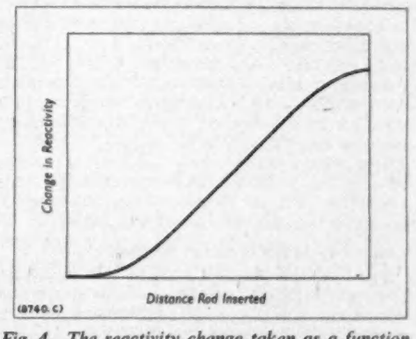


Fig. 4 The reactivity change taken as a function of the depth to which the control rod is inserted.

Types of Control Rods

There are three main control-rod types:

(1) Fine control rods are used for the adjustment of the small changes in reactivity during the running of the reactor, which may be due to depletion of the fuel or local effects. The fine rods are unable to regulate any large variation in reactivity.

(2) Coarse control rods provide for major adjustments. With the depletion of the fuel or some poisoning effect becoming predominant the fine control rods may not be sufficient to cater for the reactivity change. For this purpose rods containing a higher percentage of the absorbing element are employed. However, fine control rods are often ignored, and the coarse control

rods alone absorb the reactivity fluctuations and maintain the reactor at a constant power level.

(3) Safety rods afford emergency control and are sometimes referred to as "scram" rods. They must be capable of shutting the reactor down rapidly in exceptional circumstances and their reactivity equivalent must be greater than the maximum excess of the reactivity built into the reaction. They are usually held in position by magnetic clutches, which in the event of an emergency will be de-energised and the rods will drop into the core under gravity.

Additional Safety Measures

To back up the control-rod system an additional form of safety device is often incorporated to cater for an emergency. Borax shot is injected into the reactor if the control rod system fails in an emergency. The long-term effect of pouring shot into the core is rather disastrous, since it is very difficult to remove it without dismantling the structure. But this procedure, which has been employed in America, is preferable to the reactor getting out of control. Another method is to have a cylinder of boron trifluoride gas which can be passed into the reactor core; the release valve is in the form of a metal plug of melting point just above the maximum allowable temperature of the reactor core.

Effect of Rod Insertion

The insertion of a rod into the core alters the neutron flux distribution both axially and radially as shown in Figs. 2 and 3. The area under the flux curve is also a function of the power output and for the same operating temperature there will be a power loss. Thus to have maximum power at a given temperature it is necessary to operate with the control rods withdrawn. Insertion of a rod shifts the position of the maximum flux towards the end of the channel at which the gas enters (Fig. 2); this redistribution improves the heat-transfer properties and a higher peak flux is permissible for a given maximum fuel temperature. Fig. 3 shows that if the maximum effect is to be obtained from the insertion of another control rod it must be placed at the peak of the new flux distribution curve created by the insertion of the first rod. The rate of neutron leakage to the wall or container is also increased with the insertion of control rods due to the increase of the slope which is a function of the buckling (B).

The effect of the control rod is proportional to the diffusion area and this in turn is found to be dependent on temperature due to the diffusion area being a function of the absorption cross-section. Thus the control rod effect is also temperature dependent. It is desirable to keep the neutron flux as constant as possible over the whole region and control rods have been used as absorbers to flatten the neutron flux distribution. The effect of the change in reactivity as the control rod is inserted is shown in Fig. 4.

Control in Other Reactor Systems

All that has been said up to this point has applied to thermal reactors. If the coolant or moderator is a liquid, an additional method of control is by regulating the moderator level or bubbling a gas into the moderating liquid. In fast reactors the method of control is totally different, since the neutron absorbers usually have a low macroscopic cross-section to high energy neutrons. The reactivity in this case is controlled by the removal of the fuel material from the core. An alternative method is the movement of the reflector.

Notes and News

Suspension of ICSE

The UKAEA stated last week that the Intermediate Current Stability Experiment was to be suspended, at least for the moment. ICSE was to be of the torus design using a low pressurised gas of either deuterium or hydrogen and the current wave form was to reach the clamped discharge value within 25 microseconds. The project was designed to help scientists establish a stable plasma in the torus: until this can be maintained the full potentialities of thermonuclear fusion can not be released.

Sir William Penney said that the reason for the present suspension of the project was due to the unexpected increase in the cost and in particular the manpower required. The project was originally estimated to cost about £1·5 million but after preliminary experimental and theoretical studies £3·5 million is considered nearer the mark. The Authority consider that this will put too many of their eggs into one basket and have decided to divert their energies on to a larger number of smaller experiments. The ICSE is not the only possible answer to the pinch problem and the Authority are going to consider other hard-core geometries for example the thetatron and the use of a conductor along the ring axis of a torus design. Hard-core geometries involve the insertion of a conductor within the main field region so that the plasma takes up an annular form between the outer containment and the conductor. The smaller experiments would also give the Authority a chance to broaden its programme and further time to reflect and think: Sir William considered that it was too soon to make a decision of this magnitude at the present state of knowledge.

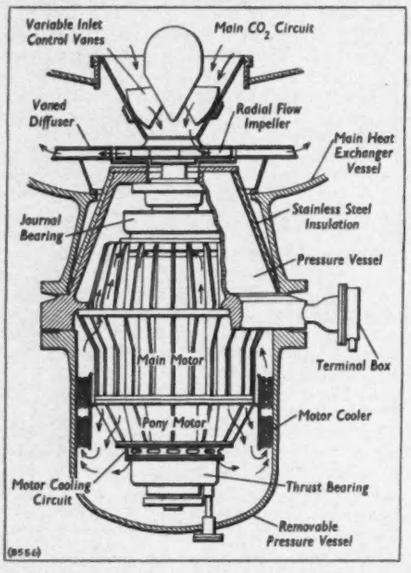


Fig. 5 Main carbon dioxide circulators for the Windscale advanced gas-cooled reactor.

Circulators for Windscale

Windscale's Advanced Gas Cooled Reactor has four main carbon dioxide circulators of a centrifugal design (Fig. 5) by Howden and Company Limited. The 1,570 h.p. motor driving the circulator are run at a constant speed of 2,970 r.p.m. and is contained in the carbon dioxide circuit. The circulator raises the carbon dioxide pressure by 28 lb per sq. in. The circulator output is regulated by a special vane mechanism. The complete system has to be able to withstand high temperatures in a very dry environment and to run without the use of any lubricants. Any maintenance has to be overcome without the depressurisation of the main carbon dioxide circuit.

Abstracts in Chemistry and Nuclear Engineering

An extensive abstract has been compiled by the UKAEA headed "Selected Abstracts of Atomic Energy Project Unclassified Report Literature in the Field of Radiation Chemistry and Bibliography of the Published Literature." The UKAEA publish a supplement annually to keep the abstract up to date. A new publication "Nuclear Engineering Abstracts" issued its first number in July. It is intended to publish this abstract quarterly. It deals with a wide range of nuclear engineering topics and gives a very full abstract of each paper or article considered.

Status Reports

The United States Atomic Energy Commission has now published the status reports on sodium graphite, pressurised water and heavy water moderated reactors for 1959. These reports give a detailed account of the USAEC's civilian power reactor programme on a technical, economic and operating experience basis. Each of the reactors in the programme is treated individually in the reports and its present and future development programme disclosed. In the majority of cases a detailed drawing is given as well as a flow diagram. The reports are available from the Superintendent of Documents, US Government Printing Office, Washington 25, DC, price $2·25.

Even Bigger Accelerators

The prospect of accelerators that may even dwarf those at Brookhaven and Cern was foreseen by Mr. J. A. McCone, chairman of the Atomic Energy Commission, at the Tenth International Conference on High Energy Physics. The first need of the future will be met by the two mile 15 GeV linear accelerator to be built at Stanford University costing over $100 million. It seemed apparent that the Russians had also appreciated this problem of size and he was aware of plans for a 70 GeV proton accelerator. It had recently been announced by Dr. R. Wilson that it was not only technically desirable but technically feasible that machines with energies of several hundred GeV should be constructed. But initially it will be necessary to examine the intermediate steps and not make such a large quantum jump.

Reports Received: Atmospherical

Windscale Accident: An analysis on the radiation effect caused by the Windscale accident in 1957 in the vicinity is given. A comparison is made with current fallouts and the effect of the recent weapon tests at that time. ("The Deposition of Strontium 89 and 90 on Agricultural Land and their Entry into Milk after the Reactor Incident at Windscale in October 1957"; F. B. Ellis *et al.*, AHSB(RP) R2.)

Catching Tritium by Balloon: Balloon flights at 90,000 ft collected samples of water vapour and carbon dioxide from which the tritium content of the hydrogen in the water was ascertained. ("Some Preliminary Measurements of the Tritium and Carbon 14 Content of the Stratosphere over England"; F. R. Barclay *et al.*, AERE—R3271.)

Another Use for Radon: It has been found that over England the concentration of the radon isotope RaD increases with height, and systematic results suggest that RaD will be a valuable tracer for further study of atmospheric processes. ("Radiochemical Analysis of Long-Lived Radon Decay Products and their Use as Natural Atmospheric Tracers," W. M. Burton *et al.*, AERE-HP/R2084.)

Environmental Check: 20 miles per hour is the recommended speed for a vehicle carrying a counter to measure the environmental radiation around Atomic Energy Establishments. The method of mounting the instrument and the type used are fully described. The knowledge of the background radiation is useful in the event of an accident. ("Vehicle Mounted Scintillation Rate-meter for Environmental Survey," I. W. Cavell, AEEW—M29.)

Analysis of Sea Water: Radioactive tracers have been used to confirm and establish methods for the separation and concentration of copper, chromium, lead and manganese from sea water, prior to the determination of their concentrations spectrophotometrically. Detailed procedures are given for the collection and determination of these elements at their natural concentration in sea water. ("The Determination of Copper, Lead and Manganese in Sea Water"; B. A. Loveridge *et al.*, AERE—R3323.)

'Engineering' Appointments Section

W. H. ALLEN SONS & COMPANY LTD.
BEDFORD

require

AN ASSISTANT ELECTRICAL DESIGNER
(Ref. 506/6)

Applications are invited for the post of an Assistant Electrical Designer to work on small to medium size A.C. machines.

The successful candidate will be between 21-30 years old and have either

(a) An H.N.C. in Electrical Engineering and previous experience in this type of work, or

(b) A degree in Electrical Engineering but whose experience in this field is limited.

In either case appropriate Membership of the Institution of Electrical Engineers is desirable.

EXPERIENCED MECHANICAL DRAUGHTSMEN
(Ref. 404/6)

Applications are invited from experienced Mechanical Draughtsmen for positions in the Turbine and the Diesel Departments. Previous experience in these particular fields is not essential provided general mechanical experience has been obtained.

The Company offers excellent prospects to the right men, good conditions of service and operates a contributory Pension and Life Assurance Scheme. Where appropriate, assistance will be given towards the expense involved in settling in the Bedford area.

Application forms can be obtained by writing (quoting the appropriate reference) to:—
THE PERSONNEL MANAGER, QUEENS ENGINEERING WORKS, BEDFORD
D 90

Newton Chambers

Due to expansion and reorganisation the Company, situated seven miles north of Sheffield, invites applications for the following vacancies within the Engineering Division.

CONTRACTS ENGINEERS (Reference 1PS/150)	Chemical Engineers or Mechanical Engineers with chemical engineering knowledge, experienced in engineering constructional work and able to handle all aspects of large contracts—probable age range 25-35 years.
DESIGN ENGINEERS (Reference 1PS/160)	To lead sections in the Engineering Drawing Office—minimum qualification is Grad. I.Mech.E —aged 30 years or over.
DESIGN ENGINEERS (DEVELOPMENT) (Reference 1PS/170)	For plant, product and production development —one position includes the general supervision of a small team of draughtsmen—age range 30-40 years.
ASSISTANT ENGINEERS (STEELWORKS PLANT) (Reference 1PS/180)	Experience in the design of steelworks plant particularly transportation equipment, gained either at a steelworks or with a contractor. Age range 25-35 years. Minimum qualification H.N.C. in Mechanical Engineering.
ASSISTANT ENGINEERS (FUEL ECONOMY PLANT) (Reference 1PS/190)	Experienced in heat exchange design, particularly fuel economy equipment, recuperators, air/gas heaters and economisers—minimum qualification H.N.C. in Mechanical Engineering.
DRAUGHTSMEN (Reference 1PS/200)	With O.N.C. but preferably H.N.C. in Mechanical Engineering for general mechanical engineering work in the Engineering Production Drawing Office. Age range 21-30 years.
HEATING AND VENTILATING DRAUGHTSMAN (Reference 1PS/210)	For Heating and Ventilating projects, preferably familiar with estimating in the heating industry and capable of preparing schemes and working drawings for all types of industrial heating installations, schools, factories, public buildings, etc.

The Company operates a contributory pension scheme and starting salaries, which are subject to annual review, will depend upon the qualifications and experience of the successful applicants. TELEPHONE Ecclesfield 3171, Ext. 22S or WRITE for application form quoting appropiate reference to:—

THE STAFF OFFICER, NEWTON CHAMBERS & CO. LTD.
THORNCLIFFE · Nr. SHEFFIELD D 127

MSL *have been retained to advise on the appointment of a*

WORKS ENGINEER

for an international company manufacturing industrial chemicals. The company is now medium sized and increasing its range of products.

The Works Engineer will be responsible for introducing planned maintenance, for the design and installation of new plant, and for advising the company on engineering matters. He will train the existing staff and will create the relevant service departments including a drawing office.
Candidates must be graduate mechanical or chemical engineers, with several years' experience of project engineering, preferably in the petrochemical or similar industrial fields.

Preferred age 35 to 45 years. Initial salary not less than £2,000 with contributory pension and life assurance schemes. Please send brief details in confidence quoting reference F.2665 to P. A. Ashworth.

MANAGEMENT SELECTION LIMITED
17 Stratton Street, London, W.1.

In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment. D 98

PUBLIC APPOINTMENTS

REPUBLIC OF THE SUDAN

Applications are invited from those suitably qualified to fill a vacancy of CONSTRUCTION ENGINEER in the CENTRAL ELECTRICITY AND WATER ADMINISTRATION, KHARTOUM, SUDAN.

Candidates should have had a recognised engineering training, and preferably be in possession of qualifications leading to corporate membership of the Institute of Electrical Engineers. Should have had considerable experience in the installation and maintenance of all kinds of indoor and outdoor substations equipment on systems up to 110 kV. A knowledge of testing and commissioning of protective gear would be an advantage.

Appointment will be on contract for a period of five years in the salary range £81075-£81675. Starting point will be fixed according to age, qualifications and experience. A variable cost of living allowance is payable and an initial outfit grant of £850 on appointment.

Annual leave accrues at the rate of seven days per month after 18 months' service.

Furnished accommodation is provided at a minimum rent of approximately £180 per annum.

A substantial bonus will be paid on satisfactory completion of the contract. There is no income tax payable in the Sudan at the present time.

Applications should be made in writing, stating age, general and technical education, qualifications, experience and particulars of present appointment, to the APPOINTMENTS SECTION, SUDAN EMBASSY, 3 CLEVELAND ROW, ST. JAMES'S, LONDON, S.W.1, quoting reference 4/3206.

Closing date 31 OCTOBER, 1960. D 110

COUNTY BOROUGH OF EAST HAM
JUNIOR ENGINEERING ASSISTANT
(MECHANICAL)

APT. 1. Salary up to £855 per annum.

Subsistence allowance may be granted over a reasonable period to the person appointed if unable to obtain suitable housing accommodation, necessitating the maintenance of two homes.

Further details and application form returnable by 21st OCTOBER, 1960, from the TOWN CLERK, TOWN HALL, EAST HAM, E.6. D 118

NEWCASTLE UPON TYNE
EDUCATION COMMITTEE
RUTHERFORD COLLEGE OF TECHNOLOGY

(Selected for Development into a College of Advanced Technology)

The Governors invite applications for the following posts of PRINCIPAL LECTURER occurring as a result of the expansion of the college, duties in each case to commence on 1st January, 1961, or as soon as possible. As the college is concerned almost exclusively with advanced work leading to external degrees, professional membership, H.N.C., H.N.D., Dip.Tech. and Post-Graduate courses, candidates will be expected to have good academic qualifications and several years of advanced (full-time) teaching experience.

(a) DEPARTMENT OF CHEMISTRY AND METALLURGY (2 posts). One post will be partly administrative in character to assist the Head in routine administration; for the other, the ability to initiate, supervise and undertake research is essential.

(b) DEPARTMENT OF ELECTRICAL ENGINEERING. Candidates should have a good industrial background with, preferably, a knowledge of power engineering and some research experience.

(c) DEPARTMENT OF MATHEMATICS. Industrial and/or research experience will be expected.

(d) DEPARTMENT OF MECHANICAL ENGINEERING. A good industrial background is essential while some research experience would be advantageous.

Salary will be in accordance with the Burnham (1959) Award, viz.: £1750 by £50 to £1900.

Further particulars and form of application (returnable within 14 days) may be obtained from the PRINCIPAL, RUTHERFORD COLLEGE OF TECHNOLOGY, NORTHUMBERLAND ROAD, NEWCASTLE UPON TYNE, 1. D 125

CITY AND COUNTY OF BRISTOL
EDUCATION COMMITTEE
BRISTOL TECHNICAL COLLEGE
ASHLEY DOWN, BRISTOL, 7.

The Governors invite applications from suitably qualified and experienced persons for the following posts in the Engineering Department.

(1) ASSISTANT GRADE B to teach mainly Electrical Installation Subjects to students following courses of City and Guilds of London Institute. Ability to assist with electrical subjects of National Certificate courses an asset.

(2) ASSISTANT GRADE A to teach mainly Workshop Practice to standard of Intermediate Certificate of City and Guilds course in Machine Shop Engineering. Ability to assist with related Workshop Calculations and Drawing in early years of this and other Engineering Craft Courses an asset.

Salaries: Burnham Technical Scale:—Assistant Grade A £520-£1000; Grade B £700-£1150. Placing on scales dependent on previous approved industrial or teaching experience. Details and application forms, returnable by 15th OCTOBER, from the REGISTRAR. D 95

CITY OF SHEFFIELD
EDUCATION COMMITTEE
COLLEGE OF TECHNOLOGY
DEPARTMENT OF ENGINEERING

Applications are invited for the following posts, duties to commence as soon as possible:—

(a) SENIOR LECTURER IN PRODUCTION ENGINEERING to teach Machine Tool Theory, Metrology, and other production engineering subjects of the new scheme of the Institution of Production Engineers to Higher National Certificate and Higher National Diploma students. The person appointed will be responsible for new, well-equipped Machine Tool and Metrology laboratories, and will be required to help with the development of the full-time (Sandwich) Diploma course and with the organisation of special courses in production subjects. An interest in the application of automatic control to manufacturing equipment will be an added recommendation.

(b) SENIOR LECTURER IN MECHANICAL ENGINEERING to teach Strength and Properties of Materials and Applied Mechanics in Ordinary and Higher National Certificate and Higher National Diploma courses. The person appointed will be responsible for the Strength of Materials laboratory, and will be required to help with the organisation of special courses in relevant subjects.

(c) SENIOR LECTURER IN MECHANICAL ENGINEERING to teach Theory of Machines and Applied Mechanics in Ordinary and Higher National Certificate and Higher National Diploma courses. The person appointed will be responsible for the laboratories concerned with Theory of Machines and Applied Mechanics, and will be required to help with the organisation of special courses in relevant subjects.

Applicants for the above posts should hold graduate or equivalent qualifications, with adequate experience in industry and/or research and teaching. Corporate membership of the appropriate professional Institution is desirable.

(d) ASSISTANT (GRADE B) IN MECHANICAL ENGINEERING (2 posts) to teach a selection from the following subjects: Engineering Science, Applied Mechanics, Engineering Drawing, Workshop Technology (production processes), Mathematics, Applied Heat, to classes in the Ordinary National Certificate course.

Applicants should hold suitable professional qualifications, with appropriate industrial and/or teaching experience.

SALARY SCALES: Senior Lecturer, £1550 by £50 to £1750 per annum. Assistant (Grade B), £700 by £27 10s. 0d. to £1150 per annum, with additions for degree and training.

Application Forms, obtainable with further particulars from the undersigned (s.a.e.) at P.O. BOX 67, SHEFFIELD, 1, should be returned within 14 DAYS of the appearance of this advertisement.

T. H. TUNN,
Director of Education. D 104

Central Electricity Generating Board

RESEARCH AND DEVELOPMENT DEPARTMENT

Headquarters, London, S.E.1

Applications Branch

RESEARCH PROJECT DESIGN ENGINEERS

Vacancies occur in the GENERATION RESEARCH PROJECT DIVISION for young MECHANICAL ENGINEERS who have lively minds and who are interested in working on specific research project design studies or on overall comparative studies in the context of the needs of the power supply system.

● **The function of the Division is to examine from an engineering standpoint, the impact of specific scientific and technical developments.** It is important, therefore, that applicants wishing to work on specific design studies should have freshness of approach and one or two years' experience of engineering research or of the design of plant or projects at the development stage.

Candidates who prefer to work in the field of overall comparative studies must have an interest in the mutual reactions of new technical developments and the economic realities of the industry and would find experience of the technical operation of large plants a useful background.

● **All applicants should have degree in engineering or its equivalent** and be prepared to work in close collaboration with experimental staff carrying out parallel programmes of work in the laboratories.

Starting salaries of up to £1375 p.a. will be offered according to qualifications, ability and experience, and in exceptional cases up to £2010 p.a. will be considered. Opportunities for promotion to higher salary grades are excellent and will depend entirely upon the contributions made by the successful candidates to the work of the Department.

Applications stating age, qualifications, experience, present position and salary, to the Personnel Officer, 24/30, Holborn, London, E.C.1, by 20th October. Envelopes should be marked "Confidential Ref. ENG/362."

D 102

NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE

requires

PROFESSIONAL ENGINEERS

at the

RUTHERFORD HIGH ENERGY LABORATORY, HARWELL

POWER PLANT ENGINEERS

POST N/5/26 EXPERIENCED ELECTRICAL ENGINEER to be responsible for testing, commissioning and subsequent operation of a 120 MVA power plant used for energising the 7,000 ton electro-magnet for NIMROD—the 7 GeV PROTON SYNCHROTRON. The plant, of novel design, comprises a large motor alternator set feeding transformers and an associated converter installation.

Duties will include the planning of machine operating conditions to suit experimental programmes, fault investigations, analysis and development work.

SALARY: £1370-£1825 p.a.

POST N/5/1/26 ELECTRICAL ENGINEER to assist in the above work and investigate various operating problems connected with the plant.

SALARY: £860 (at age 25)-£1340 p.a.

DESIGN ENGINEERS

POST N/8/26 (MECHANICAL) to be responsible for the mechanical aspects of equipment for nuclear physics research as a member of design team. Good general plant design experience particularly in the electro-mechanical field desirable.

SALARY: £860 (at age 25)-£1340 p.a.

POST N/7/26 (ELECTRICAL) to design and develop electrical systems for large particle accelerating machines.

SALARY: £860 (at age 23)-£1340 p.a.

POST N/7/1/26 ASSISTANT DESIGN ENGINEER (ELECTRICAL) to prepare circuit designs, layouts of electrical equipment and installation instructions associated with large particle accelerating machines. Experience of light current electrical equipment and electrical control systems required.

SALARY: £930-£1340 p.a.

SERVICES ENGINEER

POST N/9/26 to assist in the installation, alignment and maintenance of mechanical plant and experimental equipment. Experience in metrology and use of optical measuring instruments an advantage.

SALARY: £860 (at age 25)-£1340 p.a.

QUALIFICATIONS

Applicants for all posts except N/7/1/26 should be Corporate Members (or currently seeking Corporate Membership) of a senior Engineering Institution. Applicants for Post N/7/1/26 should have served a recognised Engineering apprenticeship or have had equivalent training and have an Electrical H.N.C. and several years' drawing office experience.

Superannuation and housing schemes.

Send POST CARD for application form to the SECRETARY (QUOTING APPROPRIATE REFERENCE NUMBER), RUTHERFORD LABORATORY, HARWELL, DIDCOT, BERKS.

D 86

MINISTRY OF POWER INSPECTORATE OF NUCLEAR INSTALLATIONS

Staff are required for the above organisation, which was set up under the Nuclear Installations (Licensing and Insurance) Act, 1959. The duties will include the safety assessment of all proposals for Nuclear Installations and the inspection of such installations during construction, commissioning, and operation. The immediate need is for—

2 PRINCIPAL INSPECTORS (salary £2700 (women £2663)-£3050); applicants should have 1st or 2nd class Hons. degree in engineering, physics, or mathematics; engineering candidates must also have achieved corporate membership of their professional institution.

7 SENIOR INSPECTORS (salary £1840 (women £1809)-£2120); applicants must normally be at least 37 and have 1st or 2nd class Hons. degree in engineering, physics, or mathematics, or have achieved corporate membership of the appropriate professional institution.

8 INSPECTORS (salary £1325 (women £1307)-£1780); applicants must be at least 30. The qualifications required are the same as for the Senior post.

Applicants without the specified qualifications but with very high scientific or professional attainments may be considered.

Candidates for Principal Inspector posts must have had considerable experience in the nuclear field of managing a team of engineers or scientists, or of industrial management.

Candidates for Senior Inspector or Inspector posts must have had wide experience of responsibility for research, design, operation, or inspection connected with large scale chemical or engineering plant. Experience in nuclear work is desirable but not essential at this stage, and candidates without this experience will be given the necessary training on appointment.

All the posts are pensionable.

For further particulars and application form apply to

CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1,

quoting **S/5216/60.**
Closing date **10TH NOVEMBER, 1960.**

D 112

TYNE IMPROVEMENT COMMISSION

APPOINTMENT OF

ASSISTANT ELECTRICAL ENGINEER

Applications are invited for the position of ASSISTANT ELECTRICAL ENGINEER, under the Commissioners' Electrical Engineer, in their Dock and Harbour Undertaking. The minimum qualification is the Higher National Certificate in Electrical Engineering and Membership of the Institution of Electrical Engineers with at least Student or Graduate status.

Applicants should have had experience in the maintenance and operation of A.C. and D.C. operated plant, control gear, substations and distribution systems, etc.

The commencing salary will be within the range £850 to £1300 per annum according to age and experience.

The post is superannuable and the successful applicant will be required to pass a medical examination and become a member of the Tyne Commission Superannuation Fund.

Applications stating age, qualifications and experience and giving the names of referees who can testify to the candidate's character and professional ability, should be sent to the undersigned in envelopes endorsed "ASSISTANT ELECTRICAL ENGINEER" not later than 25th OCTOBER, 1960.

R. N. EGGLETON,
Secretary.

BEWICK STREET,
NEWCASTLE UPON TYNE, 1. D 103

NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY

St. John Street, London, E.C.1

GRADUATE RESEARCH ASSISTANT

required for an investigation concerning CREEP AND HIGH TEMPERATURE PROPERTIES OF METALS.

The post would suit a recently graduated engineer or metallurgist wishing to work for a higher degree (M.Sc. or Ph.D.) of London University.

Salary £400-£600 depending on experience. Extra payment of £100 per year can be made in return for some assistance with laboratory or tutorial classes.

Information and application form can be obtained from CIVIL AND MECHANICAL ENGINEERING DEPARTMENT.

D 106

MSL *have been retained to advise on the appointment of an*

ASSISTANT TO MANAGING DIRECTOR

for a company in the North of England employing around 300 on specialised heavy engineering. The company is part of a group of public companies manufacturing a variety of engineering products. He will be expected to take on increasing responsibilities of management in all its phases, which should lead in due course to his appointment as General Manager of the company.

Candidates in their thirties must be qualified engineers with management experience, preferably on the technical or manufacturing side of engineering. Salary in the £1,500-£2,000 range plus bonus and contributory pension scheme. Please send brief details in confidence quoting reference F.2672 to H. C. S. Brand.

MANAGEMENT SELECTION LIMITED
17 Stratton Street, London, W.1

In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment.

D 117

LONDON COUNTY COUNCIL

POPLAR TECHNICAL COLLEGE, Secondary Technical Boys' School (280 pupils, age range 11+ to 16+)—qualified master required for—

MECHANICS (graded post, allowance £90).

Burnham P. & S. salary scale, £520 by £27 10s. to £1000 plus London allowance £38 or £51; additions for qualifications and training; increments within scale for experience.

Application forms (foolscap s.a.e.), from SECRETARY (FE.3A/E/2502/10), POPLAR HIGH STREET, E.14, to be returned by 21st OCTOBER, 1960. D 94

GOVERNMENT OF HONG KONG

ELECTRICAL ENGINEER

PUBLIC WORKS DEPARTMENT

Planning, estimating, preparing specifications and supervision of complete electrical plant installations including M.V. and H.T. switchgear, transformers and 6.6 or 11 kV motors.

Pensionable appointment. Salary according to experience within the range £1650-£2865. Free passages. Rented quarters.

Candidates must be under 45 years and A.M.I.E.E., preferably with experience in either the installation of electrical plant connected with pumping stations or the installation of heating, ventilating and lift plant in large buildings.

Write DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1, giving full names, age, qualifications and experience, quoting *BCD.112/51/012/D5.* D 92

WELSH COLLEGE OF ADVANCED TECHNOLOGY

CATHAYS PARK, CARDIFF

DEPARTMENT OF ENGINEERING

Applications are invited for the following posts, duties to commence as soon as possible:—

1. LECTURER IN MECHANICAL ENGINEERING. Applicants must be University graduates in Engineering, should normally be graduates or corporate members of the Institution of Mechanical Engineers and have had adequate industrial experience.

2. LECTURER IN MECHANICAL ENGINEERING WITH SPECIAL KNOWLEDGE OF MARINE ENGINEERING. Applicants should be University graduates in Engineering or corporate members of the Institution of Mechanical Engineers and should preferably hold a first class M.O.T. certificate together with at least graduate membership of the Institute of Marine Engineers.

Salary for both posts: £1370 to £1550 per annum, with placing upon the scale dependent upon experience.

Further particulars and forms of application may be obtained from the PRINCIPAL, AT THE COLLEGE, CATHAYS PARK, CARDIFF, to whom completed forms should be returned by 19th October, 1960.

ROBERT E. PRESSWOOD,
Clerk to the Governors.

CITY HALL,
CARDIFF. D 126

CIVIL ENGINEERS

MINISTRY OF TRANSPORT. CIVIL ENGINEERS. Pensionable posts for men and women at least 25 and under 35 on 1.1.60 (extension for regular Forces service, Overseas Civil Service, established civil service, and temporary Government service as Civil Engineer). Candidates must have achieved Corporate Membership of Institution of Civil Engineers or passed examinations necessary for attaining such membership. Experience in road and bridge construction essential; knowledge of Highways Authorities' procedure desirable. Salary (men, London) £830-£1125 according to age, rising to £1300. Promotion prospects.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting **S 64.** D 119

ENGINEERS

THE ATOMIC ENERGY DIVISION OF THE G.E.C. invites applications from ENGINEERING GRADUATES, less than 30 years of age, interested in the basic design and analysis of complex steel structures, stress analysis of shells, evaluation of temperature stress distributions, creep and pipework calculations. Previous experience of some aspects of this work is desirable though not essential and it is envisaged that successful candidates would have an honours degree in mechanical or civil engineering. Applications are also invited from young Engineers possessing a degree or H.N.C. with an interest in structural test work. The work includes the design of test rigs, ordering of equipment, liaison with manufacturers and works, and programming and supervision of tests. Previous experience of this type of work is desirable though not essential.—Write PERSONNEL MANAGER (DWB/26), THE GENERAL ELECTRIC COMPANY LIMITED, ERITH, KENT. D 85

THE ENGLISH AND SCOTTISH JOINT CO-OPERATIVE WHOLESALE SOCIETY LTD.

ASSISTANT ENGINEER

FOR

CHOCOLATE FACTORY

THE ENGLISH AND SCOTTISH JOINT CO-OPERATIVE WHOLESALE SOCIETY, LTD., invites applications for the post of ASSISTANT ENGINEER at its Chocolate Factory at Luton, Bedfordshire.

Potential applicants with appropriate qualifications and experience should write to the SECRETARY AND EXECUTIVE OFFICER OF THE SOCIETY AT 100 LEMAN STREET, LONDON, E.1, for further particulars of this pensionable post and an appropriate application form. C 83

APPOINTMENTS OPEN

NEWTON, CHAMBERS & COMPANY LIMITED
Thorncliffe near Sheffield

wish to appoint an

ENGINEERING SALES REPRESENTATIVE

based on LONDON

Applications are invited from men of mature personality who have experience of engineering sales representation in the Gas, Oil and Chemical industries. An engineering qualification would be an advantage.

The area to be covered comprises the whole of London together with the Southern and Eastern counties. A Company car is provided.

Remuneration is by salar y and expenses and there is a London Allowance. Superannuation Scheme.

Write for application form to
THE PERSONNEL OFFICER,
NEWTON, CHAMBERS & CO., LTD.,
THORNCLIFFE,
NEAR SHEFFIELD.

D 89

MECHANICAL ENGINEER SURVEYORS

MUNICIPAL MUTUAL INSURANCE LIMITED has vacancies for MECHANICAL ENGINEER SURVEYORS in BIRMINGHAM, CARDIFF and LONDON. Posts are pensionable and permanent to satisfactory candidates who should have served an apprenticeship and have sound practical and theoretical knowledge. Technical qualifications: First Class Ministry of Transport Certificate. Salary: £800 rising to £1100 per annum.—Apply in own handwriting marking the envelope "APPLICATION ENGINEER SURVEYOR" and "PRIVATE AND CONFIDENTIAL" to the CHIEF ENGINEER, 22, OLD QUEEN STREET, LONDON, S.W.1. D 87

WORKS MANAGER

required for the engineering Workshops in TRIPOLI, LIBYA, of MITCHELL COTTS & CO. (LIBYA) LTD., engaged in steel fabrication machining, fitting and assembly, with 160 employees. Age over 30 years, salary to commence £2000 p.a., with furnished accommodation and non-contributory pension scheme. Previous overseas experience preferable and ability to speak some Italian essential. Regular home leave on full pay. This post offers an interesting opportunity in an expanding business to an engineer with necessary experience and initiative.—Applications to PERSONNEL OFFICER, MITCHELL COTTS GROUP LTD., COTTS HOUSE, CAMOMILE STREET, LONDON, E.C.3. D 99

RESEARCH LABORATORY

AEI

MECHANICAL ENGINEER

age 23-25, with good honours degree, required for work on MERLIN research reactor involving design, and assessment of safety, of experimental equipment. Duties would include providing advice to sponsors of experiments and would thus, through contact with many types of radiation experiments, cover several aspects of mechanical engineering. The work could also involve research into the interactions of radiation with materials. Experience of heat transfer would be an advantage. The successful candidate would be guided initially by an experienced engineer.

The Laboratory is situated in pleasant rural surroundings near Reading with fast train service to London.

FIVE-DAY WEEK
PENSION SCHEME

Please apply in writing, quoting Reference No. R/ME/3, to the Personnel Officer,

RESEARCH LABORATORY
ASSOCIATED ELECTRICAL INDUSTRIES LIMITED
ALDERMASTON COURT
ALDERMASTON, BERKSHIRE

D 122

DRAUGHTSMEN

Draughtsmen having specialised experience in transmission hydraulics, earth-moving and construction machinery, electric motors, or switchgear, are invited to make application for positions which have been created by a vigorous expansion programme. Positions will carry attractive salaries, and offer scope for advancement in a progressive company. Modern offices and canteen facilities.

Please give full details of age, qualifications and experience in chronological order, to the SECRETARY,

BRITISH JEFFREY-DIAMOND LTD.,
STENNARD WORKS
WAKEFIELD D 124

GROUP ENGINEER

A Post of wide scope and interest

This group of companies, including the largest mass producer of lenses, the largest leading ophthalmic prescription business in the British Isles and mass production spectacle frame factory, requires a highly competent engineer of energy and vision to join its group services. The processes vary from mass to precise "one-off" techniques and involve millions of piece parts per year.

THE JOB
The core of it is to plan, organise and functionally control all engineering activities, including the design, development, layout, mechanisation, installation, materials handling and maintenance of the manufacturing units in such a manner as to provide maximum flexibility and quality at the correct economic cost. To directly control the central engineering administration and drawing office.

THE MAN
Age range 35-50; the professional qualifications for this post are obvious and require a strong knowledge and experience of production engineering, though not necessarily in the optical field.

LOCATION
London or Watford. Housing assistance provided when necessary.

SALARY
It is of prime importance to find the right man. Together with the usual benefits he can expect to commence on a very adequate salary with excellent prospects.

Initial applications giving details of age, background and experience, should be addressed to the

Group Personnel Manager
FLEMING & BRITISH AMERICAN OPTICAL INDUSTRIES LIMITED
Rochdale House,
128 Theobalds Road, London, W.C.1

D 91

SENIOR ENGINEERS

A leading British company with expanding interests in a wide variety of fields, notably in the chemical industry, has the following vacancies for qualified men aged 30/40:—

RESEARCH ENGINEER

An Honours Graduate in Mechanical Engineering is required who has had at least 5 years experience in development. The company's research effort is very large.
Reference Number 111

INSTRUMENT ENGINEER

A Graduate in Engineering or Physics is required who already holds a senior position in industrial process control. *Reference Number* 113

ELECTRICAL ENGINEER

A man is required with an Honours Degree in Electrical Engineering and corporate membership of the Institution who has had several years practical and design experience in a senior capacity. The appointment is directly responsible to the Chief Electrical Engineer and concerns electricity supply and utilization in the company's factories at home and abroad. *Reference Number* 114

Initial salaries up to £2500 will be paid. The company's conditions of service are second to none.

Please reply in confidence, quoting reference number, to :—

Robert Clive (Consultants) Limited

Appointment Consultants

26, ALBEMARLE STREET, LONDON, W.1.

D 105

JOSEPH LUCAS LIMITED

VIBRATION AND STRESS ANALYSIS ENGINEER

MECHANICAL ENGINEER required for work on stress and vibration problems associated with mechanical and electrical equipment for road vehicles.

Applicants should be capable of initiating and carrying out a programme of tests and making design recommendations based on test results.

Qualifications required include a mechanical engineering degree or its equivalent and several years experience in experimental stress analysis or similar work.

A contributory pension scheme is in operation and the Company offers a good starting salary.

Apply in writing, stating age, qualifications and experience, to the

Personnel Manager,
JOSEPH LUCAS LTD., Great King St., Birmingham 19
quoting reference PM/D/510. D 115

IMPERIAL SMELTING

(A MEMBER OF THE CONSOLIDATED ZINC CORPORATION LIMITED)

The following Staff vacancies are currently available.

MATERIALS ENGINEER

This is a new post with Consolidated Zinc Corporation (Sales) Ltd., for a man over the age of 25 possessing a good personality and with professional, engineering or metallurgical qualifications and conversant with the problems of nuclear power generation. Honours degree is preferred but the main requirement is a thorough knowledge of the engineering applications of materials and the ability to promote sales of beryllium and its alloys. A knowledge of the engineering requirements in the aeroplane structure, guided missile and guided system fields would be an advantage.

EG/ME

ASSISTANT CONSTRUCTION ENGINEER

An engineer with H.N.C. or preferably with professional qualifications in Civil or Structural Engineering and at least three years previous appropriate supervisory experience, will be required to assist in the supervision of all construction work at the Avonmouth Works.

EG/ACE

ASSISTANT INSTRUMENT ENGINEER

A Qualified Engineer with an Honours Degree in Physics, Electrical Engineering and Electronics or equivalent professional qualifications, with knowledge of instrument technology, required to design and develop instruments for the various plants on the Avonmouth site.

EG/AIE

DRAUGHTSMEN

Mechanical and Civil Draughtsmen required for design and detail work in our drawing offices. The work is varied and deals with metallurgical and chemical plant and equipment. At least two years' previous Drawing Office experience is essential and applicants should either possess or be prepared to obtain a National Certificate.

EG/DM

Applications for the above vacancies, quoting the reference of interest, and giving brief details of qualifications and experience, should be addressed to:—

CZC

PERSONNEL MANAGER,
IMPERIAL SMELTING CORPORATION LTD.,
ST. ANDREW'S ROAD,
AVONMOUTH.

D 107

INDUCTION HEATING

Delapena & Son Limited

require a

CHIEF PROJECT ENGINEER

Applicants must be qualified in either electrical or mechanical engineering, but should have background experience in both fields, with a knowledge of modern electro-mechanical handling equipment including hydraulic and pneumatic systems.

This is a progressive, well-paid position for a man able to plan the work of the Projects Department, to progress enquiries from receipt to completion of schemes and to supervise the preparation of schemes, specifications and drawings by a team of Project Engineers.

Apply in confidence, giving full details of previous experience and qualifications to —

DELAPENA & SON LIMITED
Induction Heating Division
Tewkesbury Road, Cheltenham, Glos.

D 109

SENIOR

DRAUGHTSMAN

May & Baker Ltd.
Dagenham, Essex

require a Senior Draughtsman with experience in the design and layout of chemical and similar plant installations. Applicants should have technical qualifications to Ordinary National Certificate level or higher. Salaries are reviewed annually. There is a Pension Fund and Life Assurance Scheme in operation. Excellent canteen and sports facilities.

Apply initially in writing to the PERSONNEL OFFICER, *quoting Reference No.* 170/60.

D 101

DRAUGHTSMAN

required by

NORTH THAMES GAS BOARD at BROMLEY-BY-BOW, E.3

for works maintenance of a general engineering type.

Candidates should possess or be about to take the Ordinary National Certificate in Mechanical Engineering.

Starting salary will be within the range £560 to £685 per annum in APT. Grade 2-4 according to qualifications and experience. Five-day week.

The appointment will be permanent and the successful candidate will be required to join a contributory pension scheme.

Applications, stating age, qualifications and experience, should be sent to the

STAFF CONTROLLER,
NORTH THAMES GAS BOARD,
30, KENSINGTON CHURCH STREET, W.8,
quoting reference EG/790.

D 93

ASSISTANT MECHANICAL ENGINEER

required for design and development work on cable-making machinery. Some electrical experience is desirable. Applicant should have had practical experience as well as theoretical training at least up to H.N.C. standard. He must be capable of following his designs through manufacture and subsequent application. The work is interesting and progressive and offers scope to an inventive mind. Age 25-40.—Salary commensurate with ability and qualifications.—Apply in confidence to PERSONNEL OFFICER, SOUTHERN UNITED TELEPHONE CABLES, LTD., DAGENHAM, ESSEX. D 58

INSTRUMENT ENGINEER

LAPORTE CHEMICALS LIMITED, WARRINGTON, require an Instrument Engineer to take complete responsibility for their progressive Instrument Department. Age between 26-45 years. Minimum qualifications: H.N.C. Applicants should have a thorough knowledge of modern pneumatic and electronic instruments and experience in maintenance of automatic control equipment in heavy chemical or petroleum processes. A good salary will be paid commensurate with age and experience. A Pension Scheme is in operation; and in selected cases, assistance can be given towards removal and house purchase.

Replies, giving details of age, qualifications, experience, etc., and quoting Ref. LCW/E1/71, should be addressed to the

LAPORTE GROUP
PERSONNEL MANAGER,
HANOVER HOUSE,
14 HANOVER SQUARE,
LONDON, W.1 D 123

MIDLAND SILICONES LTD.

BARRY · GLAM.

require a

PROJECT ENGINEER

to undertake the engineering of new chemical plants from flow sheet to completion. He will be responsible to the Senior Project Engineer for:—

1. Investigation of the project for estimating purposes.
2. Supervision of design and layout.
3. Co-ordination of the work of other departments concerned with new projects.
4. Procurement of materials and engagement of contractors.
5. Control, through the Erection Engineer of plant installation.
6. Planning and control of expenditure for each project.

Candidates should possess HNC in mechanical or chemical engineering and several years experience in the design and construction of chemical plants.

The Company operates both non-contributory pension and housing schemes. Good prospects of advancementi n a rapidly growing company.

Please write for detailed form of application, quoting Reference No. 11, to the

STAFF OFFICER,
GROUP PERSONNEL DEPARTMENT,
1 KNIGHTSBRIDGE GREEN,
LONDON, S.W.1

D 113

TECHNICAL AUTHOR

TECHNICAL AUTHOR required, not over 50, to undertake the compilation of operating and maintenance instruction manuals dealing with the Company's machinery. This interesting and progressive pensionable staff position would appeal to a suitably qualified Mechanical Engineer with a bias towards technical writing.—Applications should be addressed to the

Personnel Manager,
Molins Machine Company Ltd.,
Evelyn Street, London, S.E.8

D 114

DETAILERS

F. R. BULLEN & PARTNERS, CONSULTING ENGINEERS, require for their Glasgow and Darlington offices detailers experienced in reinforced concrete or structural steelwork.—Applications in writing should be sent in the first instance to DACRE HOUSE, DEAN FARRAR STREET, WESTMINSTER, LONDON, S.W.1. D 116

RESEARCH PHYSICIST (OIL HYDRAULICS)

Applications are invited for a vacancy in a small team in the central research establishment of the Vickers Group. The team is building up novel technologies and developing new types of hydraulic mechanisms. The work requires a thorough understanding of basic principles and the ability to apply it to non-conventional fields. Candidates should have some post-graduate engineering experience and a good honours degree, or its equivalent, in physics. The post is not administrative. The salary is commensurate with ability, qualifications and experience. Applications should be supported by a brief statement of qualifications and experience and sent to the MANAGING DIRECTOR, VICKERS RESEARCH LIMITED, SUNNINGHILL, ASCOT, BERKS. D 96

MECHANICAL ENGINEER

required for company operating Singapore/Malaya. Preference given to graduate Inst. Mech. Eng. Age 25-30 single. Commencing salary and allowances equivalent £1400 per annum. Free accommodation and Provident Fund. Applications which will be treated as confidential to *Box E.718, c/o Street's, 110 Old Broad Street, E.C.2.*

D 97

AC MACHINE DESIGN ENGINEER

REQUIRED (N.E. ENGLAND)

Experience of design, manufacture and testing of large solid rotor alternators and/or salient pole machines essential. Knowledge of design of exciters and motors a further asset.

Applicant preferably should have an engineering degree but minimum qualifications Grad.I.E.E. or equivalent.

Applications stating age, qualifications, experience and salary required by 17th OCTOBER, 1960, latest to BOX D 111, Offices of ENGINEERING.

GENERAL ENGINEER

GENERAL ENGINEER required as Education Officer and Instructor (Unestablished) at Birmingham Government Training Centre, Handsworth. Must be British subject, have good knowledge mathematics, be experienced and fully skilled in trade, able to teach, supervise work and maintain control of trainees engaged in trade. Should have undergone training usual in trade followed by practical experience on fully skilled work (normally at least 5 years). Theoretical test prior to selection interview and practical test after appointment. O.N.C. or C. & G. Certificate or equivalent qualifications preferable. Prospect of eventual establishment. Salary £835 p.a. at age 26 rising by annual increments to £1030.—Apply EMPLOYMENT EXCHANGE, SOHO ROAD, HANDSWORTH, BIRMINGHAM 21. D 120

CHIEF DRAUGHTSMAN

Applications are invited for this Senior Appointment from qualified Engineers who have had previous experience in modern design and practice in Constructional work including pressure, storage and floating roof tanks, pipe work, etc.

The applicant should be between the ages of 30 and 40 years with H.N.C. or Degree qualifications, and have drive and initiative.

He will be responsible for the efficient running of the Drawing Office.

Contributory pension scheme.

Salary commensurate with experience and qualifications.

Applications, giving full details of experience, qualifications and salary, should be addressed to: CHIEF ENGINEER, MECHANS LIMITED, 1071 SOUTH STREET, GLASGOW, W.4. D 121

APPOINTMENT WANTED

MAINTENANCE ENGINEER

Machine Tool apprenticeship. 3 years marine engineering on steam, diesel ships. All-round experience. Appointment in Manchester Altrincham area.—B. JOHNSON, 60 MANCHESTER ROAD, ALTRINCHAM, CHESHIRE. D 84

TECHNICAL SERVICE MANAGER

Energetic and loyal services offered to organisation with business interests in Devon, South Wales, in capacity of Agent, Representative (technical), Local Office Administrator, etc., by gentleman, engineer, ex Indian Army Major, 52, with extensive experience in industry, including major engineering projects Part time activity would be very suitable. Free for interview anywhere.—Full particulars, please, to BOX D 88, Offices of ENGINEERING.

FOR ADVERTISEMENT RATES: SEE TRADE & TECHNICAL SECTION PAGE 4

Companies

Continuing Success for Commercial Vehicles

THE largest order placed with LEYLAND MOTORS, the Lancashire commerical vehicle company, in the last weeks before the Commercial Motor Show, has been from Manchester Corporation for 40 Titan double-deck buses. They are equipped with synchromesh gearboxes and air brakes. Huddersfield Corporation has ordered 18 of the Titan double-deckers from Leyland. Other orders for Titans have come from Chesterfield, Preston, Exeter and West Hartlepool.

Leyland's have contributed a Worldmaster LRT bus chassis with a 150 h.p. underfloor diesel engine to a new road transporter to be used for the BRM racing car.

The transporter has been specially designed to navigate low narrow tunnels and difficult bridges on the roads to all the major European racing circuits. It has been built by MARSHALL MOTOR BODIES, of Cambridge and was designed by the engine development division of RUBERY OWEN, the builders of the BRM racing car.

The transporter is able to carry three cars. It has exterior panels of hand-beaten aluminium. The length has been kept to 30 ft. With its cars loaded the height is 10 ft 5 in and it is 7 ft 11½ in wide. It can also carry 31 wheels and tyres.

Bristol Cars Become Independent

The passing of the BRISTOL CARS company from the ownership of BRISTOL SIDDELEY to that of Mr. George White is the latest step in the long association between the company and one of its most enthusiastic founders.

From the start, in the years just after the Second World War, George White has been chairman and managing director of Bristol Cars. The first beginning of the company arose from the opportunity seen by a number of directors and executives of the BRISTOL AEROPLANE Company for the development of a medium sized car of high performance and the highest standards of luxury.

The first production model—the Type 400—was a four-seater saloon with a 2-litre six-cylinder engine developing 75 b.h.p. First exhibited at the Geneva Show in 1947, the Bristol 400 went on to become the highest placed British car in the 1949 Monte Carlo Rally and the third in the entire entry.

By the autumn of 1949 the Bristol 400, with a larger amount of passenger space and a more powerful engine, appeared. Around this time Frazer-Nash were winning a series of races using the Bristol engines and chassis components.

A 100 b.h.p. engine went into the Bristol 403 in 1953. This was the year that in New York the World Motor Sports Show awarded a Bristol car the trophy as the best engineered sports model. In the Le Mans race of the following year the Bristol team finished first, second, and third in their class and won the team prize.

Five years ago the Bristol 403 and 404 were discontinued and the production capacity concentrated upon the 405 saloon and the drophead styles.

The current model is the 406, with a 2,216 cc engine and disc brakes on all four wheels. This is the car which will be shown at this year's Motor Show.

The car division of Bristol underwent its first transformation in 1955 when it became a subsidiary company and in 1959 it was transferred as a subsidiary to the then newly formed BRISTOL SIDDELEY ENGINES.

Acting with George White in taking over the concern as an independent company is Mr. T. A. D. Crook, managing director of ANTHONY CROOK MOTORS, a leading Bristol distributor and himself a competitor in Bristol and Frazer Nash cars.

Oxygen Steelmaking and Wellman Prosperity

Manufacturing oxygen steelmaking installations in three of the major British additions to steel making capacity and playing an important part at the Indian Durgapur steelworks, the WELLMAN SMITH OWEN ENGINEERING Corporation have had a good year.

The Corporation's trading profit before tax has risen from £1,433,892 to £1,779,348.

One of the most significant of the Wellman developments of recent years has been last November's conclusion of an agreement with VEREINIGTE OSTERREICHISCHE EISEN-UND STAHLWERKE, originators of the L D oxygen steelmaking process, for the collaboration of the two companies in the installation of L D plants in Britain and certain foreign territories.

As the result of this agreement Wellman are now engaged on contracts for L D installations at the Spencer works in South Wales of RICHARD THOMAS & BALDWINS; at Ravenscraig, Scotland, for COLVILLES; and at the Scunthorpe, Lincolnshire, works of LYSAGHT. Other contracts are on the way.

This side of the engineering corporation's activities has grown to an extent that the sales side of the furnace building and contracting section is now operating as a wholly owned subsidiary, WELLMAN SMITH OWEN (FURNACES) LIMITED.

The contracts at home and abroad completed during the financial year were a record for the corporation and the contracts now in hand stand at more than £9 million. The chairman, Sir Peter G. Roberts, forecasts a continued increase in the activities of the group.

Approval for Atlas Copco Acquisition

ATLAS COPCO, the Swedish compressed air engineering group, has secured the approval of its shareholders for the increased share issue involved in the purchase of the drilling group SVENSKA DIAMANTBERG BORRNINGS.

Atlas Copco have subsidiaries in 29 overseas countries and agency arrangements in another 61. The Diamantberg Borrnings concern brings to the group foreign associates specialising in drilling operations for soil testing, rock strata, mines and deposits of ore. Their London associates are the Craelius Company and there are others in Paris, Nairobi, Rome and Dusseldorf.

Approval was given by the Atlas Copco shareholders at a special meeting in Stockholm.

Made in Britain for Arab Pipeline

It is not much good doing a job for people if you fail to tell them that the job is done and who did it.

DAVID BROWN took no chances over their recently completed order for a

number of valves for the 24 in pipelines of the IRAQ PETROLEUM Company. The valves, weighing 6½ tons, were made by the DAVID BROWN FOUNDRIES Division, at Pennistone, in Yorkshire. They were shipped through Liverpool to Latakia, Syria.

From Latakia to their destination the crates carrying the valves proclaim, in carefully inscribed Arabic (inset) the splendid slogan—"Made in Britain."

Civil Engineers Open in Northern Rhodesia

The Peterborough and London civil engineering firm, MITCHELL CONSTRUCTION, are to open an office in Lusaka, Northern Rhodesia. It is intended that the Mitchell office will undertake building and civil engineering works throughout the Central African Federation.

The Mitchell company, which includes a number of United Kingdom firms, has two subsidiaries in Canada.

Change of Name for Northern Aluminium

In order to more clearly identify the Northern Aluminium Company as a member of the ALUMINIUM LIMITED of CANADA group its British company has changed its name, from 15 September, to ALCAN INDUSTRIES Limited. Aluminium Limited, the largest aluminium producer in the world, is responsible for about a fifth of the primary aluminium production of the West. The group has companies in more than 25 different countries. The heart and centre of the group is the use of hydro-electric power in Canada for the smelting of bauxite mined in tropical regions.

Smelting is carried on in five countries other than Canada and fabrication of the aluminium into forms usable by industry is carried on in a total of over twenty countries.

The former Northern Aluminium firm, which is over fifty years old, turns Alcan ingots into sheet, plate, sections, forgings and castings. The move away from the original name of Alcan subsidiaries towards the Alcan Industries form is taking place throughout the group. Its purpose is to emphasise the common identity of the organisation and to stress the Commonwealth nature of the group.

Alcan Industries will continue to use the Noral trade mark established by Northern Aluminium.

Development Division Formed by Distillers

The DISTILLERS Company have formed a new DEVELOPMENT DIVISION in their Industrial Group. The division will be responsible for the direction and coordination of the company's research, forward planning and licensing activities, particularly in connection with chemicals and plastics.

The controller, manager of the planning department and manager of the licensing department will operate from 21 St. James's Square, London, SW1. The manager of the central research department from Great Burgh, Epsom, Surrey.

Three-fold Increase in Profits

The KIRKSTALL FORGE ENGINEERING Company, manufacturers of axles for buses and commercial vehicles, and drop forgings report a profit for the past financial year increased from £52,747 to £156,628.

Mr. R. F. Butler, the chairman, points out that against this has to be read the change which had to be made, by agreement with the Inland Revenue authorities, in the valuation of Stock and Work in Progress. This valuation had in the past always been extremely conservative, on a basis which was no longer acceptable to the Inland Revenue.

The heavy overdraft carried by the company, £487,515, was singled out for special mention by the chairman, and must be typical of bank charges carried by a number of medium sized engineering concerns.

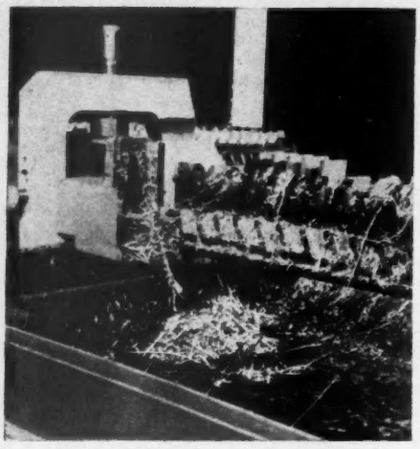
Early last year trade was particularly quiet and Kirkstall Forge was reducing stocks as much as possible. In the autumn, with very little warning, the company's customers increased their demands to a level which had not been met since 1956. A considerable increase in the purchases by the company took place. As the result a good deal more money is tied up in this way than would normally be the case. The chairman expects this position to improve during the year.

KIRKSTALL-REPCO, the Australian subsidiary, had a good year in the previous financial period. Last year they did even better and the home company received its first dividends, £14,941.

So long as there are no further financial restrictions and the international situation does not deteriorate, Mr. Butler looks forward to improved results this year. Order books are full and the only difficulty in getting deliveries out as quickly as the company would like is that of obtaining all the raw material wanted when it is needed.

(Left) The exit end of the machine, showing the operator on the electric truck which carries him from one end of the workpiece to the other.

(Right) The broach after a pull, showing the disposition of the chips.



Unit Construction Broaching Machine

A new type of broaching machine, constructed on the building block or unit construction principle has been developed by the Lapointe Machine Tool Company of Hudson, Massachusetts, USA. This method of construction enables the machine to be lengthened at any time to accommodate longer work pieces.

An example of the machine has recently been installed at the plant of the Kama Aircraft Corporation. It is a 64 ft horizontal broaching machine which is used for broaching large helicopter blades. Blades are machined from long hollow extrusions. The inside contours are first broached and the exterior is then milled to give the required shape.

A tough aluminium alloy is used for the blades. In its extruded form, it has hard spots, and these make machining difficult. Internal broaching operations are complicated by the tendency of the aluminium to form long, stringy chips. It is imperative to machine the inside of the contour to remove an oxidised layer left by the extrusion process.

During broaching, about $\frac{1}{4}$ in of stock is removed. The design calls for a 30 μ-in finish and straightness must be held within $\pm$ 0·005 in.

It was found that no machine existed which had the capacity to accommodate such long parts and which could satisfy the accuracy and surface finish requirements. Further, because helicopters are consantly increasing in size, it was necessary to provide a means for increasing the capacity of the machine when it became necessary.

The resulting machine was developed over a period of two years. Basically, it is a horizontal pull broach with a 340 in stroke. It is powered by a 50 h.p. electro-mechanical drive which provides a steady pull on the draw bar during broaching and also returns the draw bar to the initial position after each pass. The machine will broach at speeds up to 80 ft per min.

Eight clamps hold the spar in position for broaching. Because of the length of the spar and the large amount of stock removed, over 30 passes are made to complete each part. Each pass is made with a separate broach. Cutters are made of high speed steel and are designed as inserts to be mechanically fastened into toolholders. The inserts allow much lower tool costs than would be possible with solid high speed steel cutters, since the holders can be made from relatively cheap alloy steels. Each tool is numbered in sequence so that the operator has no trouble in performing successive operations in the right order.

All broaches are sorted on a conveyor that carries them from one end of the machine to the other and tool changes are facilitated by two hoists. A hoist at the front end of the machine lifts a tool from the end of the conveyor and swings it into position in front of the draw bar. A hoist at the other end of the spar removes each broach after completion of the pass and deposits it on the conveyor.

This conveyor has greatly reduced the amount of time that would otherwise be required to handle and change tools. Another way in which the productivity of the broaching machine has been increased is through the use of a small electric truck which carries the operator between the two ends of the workpiece. This truck is, in effect, a travelling platform that enables the operator to be in position to attach or remove tools without delays.

In operation, a broach is taken by the hoist off the conveyor and attached to the draw bar, which is in position in the spar. The operator then presses the starter button and the broach begins to travel through the spar. During broaching, the operator travels to the other end of the spar on the moving platform. When broaching is completed, he disengages the broach from the pull bar and, again using a hoist, positions it on the conveyor. He also cleans chips from the broach and the end of the part as necessary. As the pull bar returns through the spar and causes the conveyor to index, the operator and moving platform return to the initial position to start a new cycle.

The machine is built up from a 40 ft centre section and two 12 ft end sections. If it becomes necessary to broach longer spars, only new end sections would have to be added.

The UK associate company of the makers are the Lapointe Machine Tool Company of Watford, Hertfordshire.

Analogue Computer for Process Control

The System Engineering Group of de Havilland Propellers Limited of Hatfield have developed an inexpensive analogue computer for the process industries. The computer, known as Anatrol, can monitor and control a wide range of manufacturing processes.

The formula for the operation of the plant is stored in Anatrol as a mathematical model, by means of a number of equations which form the programme of the computer. The state of the plant and the materials flowing into it and through it are made known to the computer by signals fed to it from measuring instruments. With a knowledge of these equations and measurements, the computer is able to determine and adjust the control settings required for the plant to operate at peak efficiency. Measurement, calculations and any necessary control changes proceed continuously.

In Anatrol, the analogy appears in terms of d.c. voltages. These are manipulated within the computer to give an overall average computing accuracy of $\pm$ 1 per cent of full scale, a value equivalent to that of the standard types of instruments and controllers used in process plant; the computer is not, therefore, operating at an unnecessarily high standard of accuracy. This, coupled with the fact that Anatrol accepts input signals and transmits control signals in analogue form, matching the signals transmitted and accepted by normal plant instruments and thus eliminating the need for analogue/digital and digital/analogue converters, results in a computer which is very much less expensive even than the simplest of digital machines.

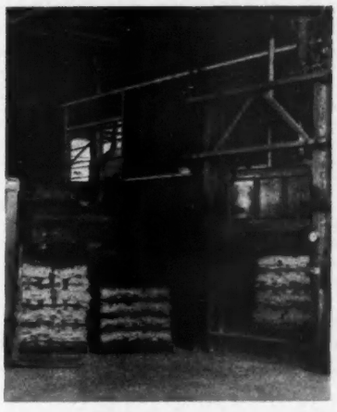
Modular construction is employed so that only those units required for a particular control problem need be incorporated. It makes use of a time-shared computing system in which a minimum of mathematical units, usually one multiplier and three amplifiers, is brought into operation repeatedly during a calculation sequence by a 25 position switch which moves at a rate of one step a second. The accuracy of computing at each step is $\pm$ 0·1 per cent. The mathematics are solved by the units in a series of steps which are controlled by the switch, and the results of each step are stored until they are brought into the sequence again or fed to control units on the plant. Depending upon how many steps are necessary for the solution of the equations, fresh levels of control signals are fed to the plant every few seconds. If five steps are required new levels are set each five seconds, and these are transmitted continuously until the next values replace them. The longest period between the setting of fresh values is 25 seconds, this being the full capacity of the computer.

Anatrol can receive up to 42 separate signals from the plant, and can transmit six output signals. If necessary, more than one computer may be used at the same time; each one being able to communicate with the other to form one large unit with correspondingly increased plant control facilities.

Pressed Loads Save Space

A hydraulically-operated pallet-levelling press has been put on the market by Heenan and Froude Limited of Worcester. It makes possible the fuller use of storage capacity for bagged chemicals and similar dry powders.

One of these presses, which does nothing more complicated than to apply an even vertical pressure on a pallet load of bags, has successfully increased the existing storage capacity of a Midlands chemical company by about 50 per cent. The company concerned, which produces several hundred tons of chemical powders each



Pressed and unpressed loads.

day, dispatches most of its output in 56 lb paper sacks, which, after filling, are stacked 40 to a pallet and shifted by fork lift trucks.

Prior to the advent of the press, the loaded pallets could only be stacked to a height of two pallets and, as production increased, the existing warehouse facilities were becoming inadequate. The press has reduced the average overall height of a load from 4 ft 2 in to 3 ft 1 in. This compression combined with a notable improvement in the stability of the stack has made it possible to store the pallets in tiers of three instead of two.

A further advantage of the compacted stacks is that loads for dispatch by road transport ride more securely and, as the pressed effect on the sacks is reasonably permanent, the space-saving benefits are passed on to the customers.

Heenan and Froude state that the hydraulic press could be applied successfully to practically any type of bagged material. The development is likely to appeal particularly to companies operating in towns and cities in which additional and conveniently situated storage space is difficult and expensive to acquire, and also to shipping concerns.

Measuring Levels with Moiré Fringes

An ingenious piece of equipment which determines the height of a liquid in a tube or a burette to 0·01 in has been devised by chemical engineers of the Atomic Weapons Research Establishment. The equipment makes use of Moiré fringe light diffraction patterns. It can be worked by direct, remote or automatic control and can be arranged to feed information to an electric counter or to a pen recorder.

The heart of the device is a mobile carriage which is assembled around the tube. One half of the carriage contains a light source, two gratings, one fixed and one movable, and a photoelectric cell. The other half, on the opposite side of the tube, contains two photocells.

Operations begin with the carriage at the top of the device. Light passes through an 0·02 in slot in the carriage, and through the two gratings to the photocell. As the carriage moves, Moiré fringes are produced by the relative movement of the two gratings so that the light is cut off once for each grating line, i.e. in this case every 0·01 in.

Although these light flashes to the cell are going on all the time in the downward sweep they are recorded only between a zero shield and the meniscus of the liquid. This is because the previously mentioned slot can also allow light to travel through the burette and fall on the other two photocells. At the start of the sweep, the zero shield cuts off this light, but as soon as the carriage moves down past this datum level, the light falls on the cells which then actuate the counter circuit or the pen recorder. On reaching the meniscus, the light is cut off and counting stops.

Nailing in Half the Time

The accompanying illustration shows a pneumatic nail driver developed by employees of the New Zealand Ministry of Works working on the 540 kW Benmore hydro-electric project. The device is producing substantial savings in time in the construction of nail-laminated timber decking for bridges.

Access bridges play an important role in construction work at Benmore. To make dismantling easier after bridges have served their

Pneumatic hammer.

purpose, it was decided to use laminated timber decking rather than the conventional concrete.

An order was placed with the carpenter's shop for 22 laminated sections varying in weight from 4·85 tons to 3·78 tons and with a combined weight of about 100 tons. Some 55,000 sq. ft of timber was involved. A nail pattern averaging one nail to every 6 in of laminate meant the use of more than 2 tons of 5 in galvanised nails, or roughly 70,000 nails.

It was clear that this would take a long time, so a prototype pneumatic hammer was developed, with a hand rock drill as the power source. However, the bit that transmitted the force to the nail head presented a problem, as the initial tests showed that the bit would not stand up to the severe punishment incurred during operations. Eventually, research proved that a No. 3 carbon steel bit withstood the battering.

The bit comprised a non-rotating shank to fit the machine and a parallel shaft about 6 in long and $\frac{3}{8}$ in diameter. Over this was fitted a sleeve which normally extended some distance beyond the end of the shaft and was held by a coil spring to the base of the shaft. The sleeve held the bit on the head of the nail, recoiling when the nail was driven home. Old tractor valve guides were used for the sleeves. These served the purpose well, being easily replaced when broken.

The positions of the joins in the planks were determined beforehand according to the lengths of timber supplied. Each length of timber, as it were cut according to a schedule, had its place in the assembly and no sorting or measuring was needed once it was released from the sawyer.

A 64 ft length of roller conveyor was set up at bench height and a cross-cut saw was placed 16 ft from the right hand end. This enabled one man to cut the timber to the required length and push it down to the marking jig at the far end with the minimum of effort.

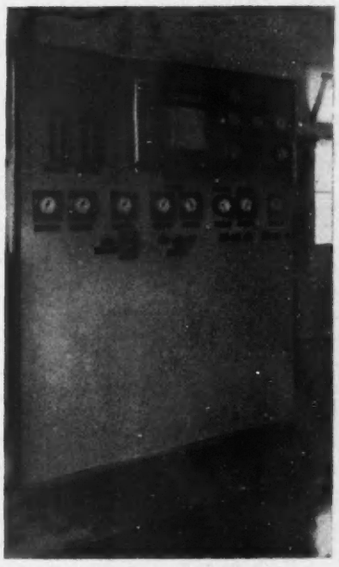
A nail pattern marker was a great time saver. Briefly, it consisted of a bench drilled with holes through which spots of coloured powder was blown on to the planks in the desired pattern with the aid of a source of compressed air. No tests were taken on the marking, but it was estimated that a man with a template and punch would take at least one minute to mark out a plank. With the compressed air and powder system, the operation was done in two seconds.

Speed comparisons show that four men with claw hammers took 4¼ minutes to nail one length of planking containing 62 nails, or the equivalent of 17 man-minutes a plank. One man with one pneumatic tool took 8½ minutes to do the same: a 50 per cent saving in time.

Pilot Brewery Automatically Controlled

A pneumatic control system, designed by the Instrumentation Division of Associated Electrical Industries Limited in conjunction with Robert Morton and Company Limited, brewer's engineers, has been installed at the latter company's Burton-on-Trent works.

It is reported that this is the first time that an automatic control system has been applied to a brewery plant in this country. Although the pilot plant is for conventional batch brewing, it is said that the control system represents an important step in the development of a continuous



Centralised controllers and indicators.

brewing process. The equipment can be applied to existing plant, providing an accurate method of ensuring consistent quality by precise control of temperature and flow, and by automatic control of a pre-determined fermentation programme. The system uses standard AEI instruments working in the 3 to 15 lb per sq. in range. The control valves "fail to safe" and an auto/manual facility is provided in each control loop.

Changing Centrifugal Pump Performance

There are three simple changes to the impeller of a centrifugal pump which will amend the performance without any significant loss of efficiency.

By F. A. Varley, M.Sc. (Eng.), Ph.D., A.M.I.Mech.E.

Royal Military College of Science, Shrivenham

ALTHOUGH manufacturers of centrifugal pumps can be relied on to ensure that their products meet the given specification, it is not uncommon for an occasion to arise where the user requires the later performance of a pump to differ somewhat from its designed output, as for instance when the original pipework or ancillary fittings are modified. In process work and refineries particularly, large numbers of similar pumps are employed and from the maintenance point of view it is desirable that a standard type be used to ensure maximum interchangeability. Here again, for maximum economy of operation, it may be necessary to amend the performance of the standard pump to match a particular required duty.

In the absence of any speed control on the driving motor, the commonest means of varying the output of a pump is to throttle the delivery; it may indeed be the only practical method when the demand is variable. Throttling, however, always wastes power and, for a moderate but permanent change in performance, various simple modifications of the pump impeller can be employed which do not entail any appreciable loss in efficiency.

Reducing Impeller Diameter

If, on test, a particular pump generates too high a head or delivers too large a quantity, it is general practice to turn down the impeller in a lathe. With diffuser pumps the impeller shrouds are usually left undisturbed to give better guidance of the water into the diffuser vanes, and only the impeller vanes are cut away. For pumps with volute casings, the shrouds may be turned down as well, particularly if the cut-water clearance is small.

Approximate relationships commonly proposed[1, 2] for predicting the effects of reducing the diameter of an impeller are that the head varies as the square of the diameter and the discharge is proportional to the diameter. However, further examination of the theory shows that the precise relationships must depend on the impeller geometry, in particular on whether the flow area at the impeller periphery and the exit angle of the blades are altered when the impeller is turned down. Moreover, there is a lack of published data giving experimental verification of the scaling-down rules and, as a consequence, trial and error methods are usually resorted to achieve the required performance.

In the course of an investigation[3] into various aspects of centrifugal pump impeller design, carried out at the Royal Military College of Science, Shrivenham, some data was collected on the changes in performance resulting from a reduction in impeller diameter. The pump used was a 2 in double-entry type with an impeller 9·6 in diameter. The impeller diameter was reduced in steps of 0·4 in down to 8 in and the resulting peak efficiency performance of the pump at 1,400 r.p.m. is shown in Fig. 1.

It might be noted first that a moderate reduction in impeller diameter caused only a small decrease in pump efficiency—when the diameter was reduced by one-twelfth, the fall in efficiency was approximately 1 per cent. Both the head and the discharge with turned-down impellers were less than those predicted by the above quoted relationships (shown by broken lines in Fig. 1). Further analysis of the results yielded the experimental rules:

$$\text{Head} \propto (\text{diameter})^{2\cdot48}$$
$$\text{and discharge} \propto (\text{diameter})^{1\cdot21}$$

These values of the indices can only be expected to apply exactly to an impeller whose geometry is similar to the one tested but they illustrate the extent to which the theoretical relationships overestimate the diameter reduction required.

Relieving Vane Exit Tips

A second technique used to affect small changes in the performance of a pump is to modify the shape of the exit tips of the impeller vanes. If the pump output is too high, the tips are filed away to a taper form by removing metal from the front of the vanes, whereas, if the pump head is deficient, it may be increased by filing away the trailing side of the vane tips.

This method is essentially trial and error because, even if it were possible to determine precisely the required amendment to the shape of the vane tips, it would be difficult to achieve it in practice by hand filing, bearing in mind the inaccessibility of the internal passages of the normal cast impeller.

However, theory suggests that the changes in pump performance brought about by this technique are due to the resulting changes in the effective vane angle at outlet from the impeller. Trimming away metal from the front of the vanes, decreases the vane exit angle, leading to a smaller whirl velocity in the velocity triangle at outlet and a consequent reduction in the Euler head. Conversely, though both the velocity and its direction at the exit from the impeller vane passages have been shown to be far from uniform, removing metal from the trailing side of the vane tips causes an increase in the average exit angle over the impeller passage, thereby increasing the Euler head. A secondary contributory factor may be the increased peripheral flow area following the filing down of the vane tips which would tend to reduce the velocity of flow and increase the velocity of whirl.

The results of some tests on the pump described previously showing the effects of tapering-off the trailing side of the vane tips are given in Fig. 2. At the design capacity of the pump (85 g.p.m.) the head is increased by over 6 per cent but the increased output required a relatively greater increase in the power input and the efficiency falls approximately 2 per cent. This suggests that modifications to the outlet tips of the impeller vanes may lead to unfavourable changes in the velocity distribution and greater mixing losses in the volute.

Machining External Shroud Surfaces

It may not be generally realised that cleaning or machining the outer surfaces of the shrouds of a cast impeller, with the object of improving the efficiency of the pump, may lead also to a reduction in output. In fact, the tests mentioned earlier showed that these shroud surfaces make a significant contribution to the output of the pump, something like one-third of the power consumed in disc friction.

Fig. 3 gives performance curves for the pump with an impeller whose outer surfaces are first machined and polished and then roughened by a uniform coating of sand, mean grain size 0·019 in. The curves show that this degree of roughness increased the head generated by some 3 ft to 5 ft over the complete discharge range, or by approximately 6 per cent at the peak efficiency point, but at the same time, the value of this peak efficiency fell by over 2 per cent. Different degrees of roughness were found to have similar effects.

References

[1] Addison, H., *Centrifugal and Other Rotodynamic Pumps*, p. 216, Chapman and Hall, 1948.

[2] Church, A. H., *Centrifugal Pumps and Blowers*, p. 70, J. Wiley & Sons, 1945.

[3] Varley, F. A., *The Influence of Various Aspects of Impeller Design on the Performance of Centrifugal Pumps*, Ph.D. Thesis, University of London, 1959.

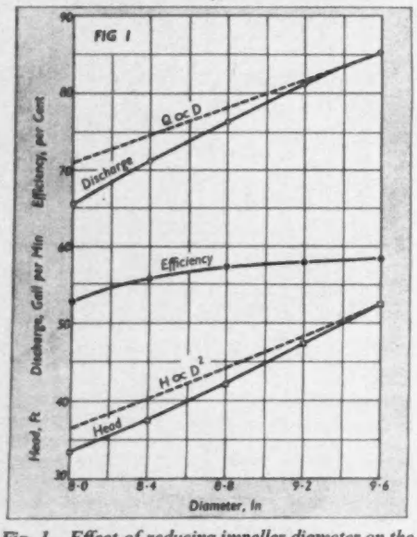


Fig. 1 Effect of reducing impeller diameter on the working head, discharge and efficiency.

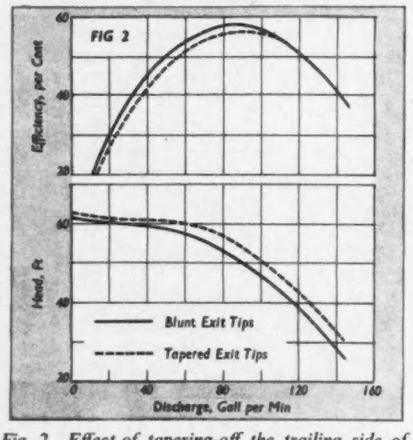


Fig. 2 Effect of tapering-off the trailing side of the impeller exit tips.

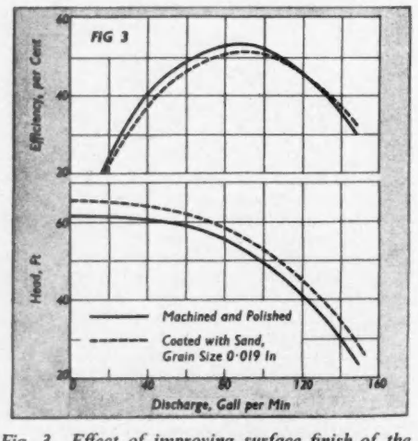


Fig. 3 Effect of improving surface finish of the impeller shrouds on pump performance.

Automatic Coal Transfer from Wagon to Ship

Two coal shipping plants, each capable of transferring coal from railway wagons to ships' holds at a maximum rate of 1,350 tons an hour, have been installed at Immingham, Lincolnshire. Each plant is operated by only two men. The equipment was designed and constructed to the requirements of British Transport Docks by Mitchell Engineering Limited, Peterborough. The two plants, which extend about 350 ft back from the quay face, stand 400 ft apart on South Quay.

Tonnage handled varies with wagon size. Both plants are designed to handle 55 wagons an hour, and these can be between 10 and 24·5 tons capacity. In a recent trial one plant shipped a cargo of 17,500 tons of washed small coal from small capacity wagons to the Norwegian bulk cargo vessel, the m.v. Providence, in a record time of 29½ hours at an average rate of 600 tons an hour.

Electrically operated, the plants are made up of a combined wagon haulage and tippling device connected by belt conveyor to a 100 ft loading tower on the quayside. An adjustable boom discharges the coal into the ships' holds. The flow of coal is continuous, and the sequence of events leading up to it is fully automatic.

Wagons to be unloaded are marshalled on the sidings at the lower end of the inclined gantry and gravitate to a predetermined position at the foot of the incline leading up to the tippler. A haulage mule, with a hook for engaging the coal wagon coupling chain, runs on its own track between the wagon tracks. It is propelled up and down the inclined gantry by steel wire ropes running from an electric winch underneath the gantry. The tracks run up at 1 in 4 over a reinforced concrete gantry to the high level platform housing the tippler.

The mule is normally held at the top of the incline, and is set in motion by the tippler plant operator pressing the start button of the electrical control system. The automatic sequence of events then continues until the stop button is pushed.

Once started, the mule travels down the inclined track, passes under the wagon standing at the bottom of the incline, reverses, engages with the wagon chain, and hauls the wagon up to the platform, stopping close to the tippler.

Just before the mule comes to rest a " placer " takes charge of the wagon. The placer runs on a separate track alongside the wagon track on the platform at the top of the incline, and is hauled to and fro by a steel wire rope attached to a separate winch. It has a folding arm which automatically rises at starting to engage with one of the wagon rear buffers. The wagon is then pushed forward on to the tippler cradle, thereby disengaging the wagon chain from the mule. Here the placer stops and returns to its initial position, ready to receive the next wagon, lowering its folding arm on the way. Meanwhile the mule has started back to bring up the next wagon.

Fig. 1 Wagons are hauled by an electric motor to the top of the gantry and placed on the tippler. Emptied, they are pushed on by the next one.

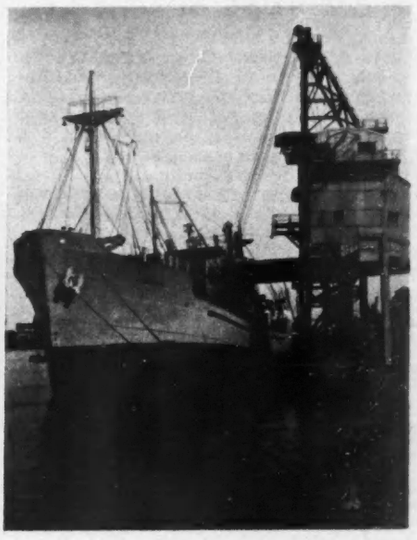


Fig. 2 From the tippler the coal passes continuously by conveyor belt to the loading tower, which is equipped with a telescopic boom.

As the placer starts its return journey the tippler, driven by an electric motor through rack and pinion gearing, elevates the wagon and tips the coal into a hopper. After a brief pause to allow the wagon to empty completely, the tippler returns the wagon to its upright position, by which time the next wagon has reached the top of the incline. When this is moved forward by the placer, it pushes the empty wagon off the tippler cradle and takes its place. The empty wagon runs away down an incline and up a rising ramp; it comes to rest and reverses back to catch points which divert it to a falling gradient for gravity return to sidings level.

From the tippler hopper the coal is discharged by means of an apron plate feeder driven by an electric motor, which in turn delivers it to the belt conveyor for the loading tower. By adjusting the rate of feed by means of a rack and pinion gate, a steady flow of coal is maintained.

The tippler cycle takes 40 seconds. The mule haulage speed, return speed, and the placer speed at 240, 480 and 180 ft per minute respectively. One operator, housed in a raised cabin on the elevated gantry adjacent to the tippler, controls the wagon haulage, placer, and tippler, having a clear view of their operation. The second operator, housed in a cabin mounted high up in the tower structure, controls the apron plate feeder, belt conveyor, boom lifting and telescoping motions, and slewing of the tower. His cabin affords a clear view of the ship's hold and surrounding gear.

A 60 in wide belt conveyor running at 400 ft per minute transports the coal in a stream up to the loading tower and on to the adjustable boom for discharge into the ship's holds. The whole tower structure is mounted on a radial rail track at the quayside and supported on a swivelling pintle at the rear end, so that the boom may be travelled fore and aft over the hold. Limits of boom extension are 60 ft maximum and 10 ft minimum, beyond the quay face; and the range of slewing at maximum extension is 130 ft. In addition the boom can be raised or lowered, from 5 to 60 ft above the quay, to suit the level of the hold.

The two operators are in telephonic communication with each other and also with the wagon marshallers at the foot of the inclined gantry. The electric control gear is so arranged that automatic operation can be discontinued and each motion operated separately by hand, for instance when testing. The conveyor and feeder can also be run at half speed if required, for filling ships' bunkers, or for topping up holds.

Computers Prepare Statistics on People

A census of population has been held in the United States this year. Next year one will be held in Britain. In both countries computers will analyse the results of the head counting.

The Univac 1105 computer at Armour Research Foundation, Illinois Institute of Technology, started on the US decennial census on 20 July. It will process about 45 per cent of the population's statistics. Similar computers at the Bureau's headquarters near Washington, D.C., and at the University of North Carolina are processing the characteristics for the remainder of the population.

The Illinois computer started by processing the information for the State of Illinois, thus beginning the fourth stage in the five-stage process of producing the final certified 1960 census. In the first stage, the characteristics for about 179,500,000 people were collected during April by some 200,000 census enumerators. The records were sent to the Bureau's Jeffersonville, Indiana, office were they were microfilmed. After developing the microfilm was fed into FOSDIC (Film Optical Sensing Device for Input to Computers) which translated enumerator entries (excluding names and addresses) into impulses on magnetic tape. Computer processing of the magnetic tape follows. The final step in the process, review of specific areas, checks the validity of the overall procedure.

In Britain, the IBM 705 computer, installed with the Royal Army Pay Corps at Worthy Down, Hampshire, will be used to analyse the 1961 census. For this purpose the whole country will be divided into 70,000 Enumeration Districts. Each will have its own enumerator who will deliver a schedule to every householder in his district. Each householder will be required to supply some details of his house, together with particulars of members of his household. In addition, householders in a random sample of one in ten will have to give information about education and jobs.

Information from the schedules will be punched into cards on some 80 keypunches rented from IBM United Kingdom Limited, then the cards will be transcribed on to magnetic tape. Further cards will be prepared for the additional information gained from the 10 per cent sample. The tapes will then be passed through the IBM 705 for statistical counts to be made according to the various classifications. These will be produced initially in punched card form and then printed on an IBM Cardatype.

On the Shelf

By Frank H. Smith

I KEEP an assortment of disguises at the office. You never know when someone is actually going to read this lot and guns sometimes blaze in the most unexpected places. Take Mark Paterson (this column, 12 August, p. 222). *He* didn't see it but had his attention called to it by a friend. Luckily the material was not insulting this time and I've had a pleasant letter from Mark himself telling me that Shoe String is operated by the Librarian of Yale (University not Locks), that the prices given were bobs not bucks (an implied rebuke here) and sending me two more library-science books by Shoe String—*Of, By and For Librarians*, by John David Marshall, at 56*s*, and *Twenty-Five Cases in Executive-Trustee Relationships in Public Libraries*, by K. E. Shaffer, at 36*s*. If you are too lazy to look up my previous column yet still want the books, Mark Paterson and Company Limited operate from Beech House, 34-36 Beech Street, Barbican, London, EC1.

When I first went into an office, with a shipping firm, the clerk who did the bills of lading for Pinchin Johnson used to have to ring them up almost daily with queries. Everytime he would say "Are you Pinchin Johnson?" and then, when the girl said "Yes," he would say "Well stop it" and laugh like a drain. Which brings me to their new "informative broadsheet" (I quote, of course) entitled *Top Cover*. It's quite a jolly little four-pager which should be expanded. Get your copies from Pinchin Johnson and Company, 4 Carlton Gardens, London, SW1, and tell 'em I told you.

It is not often that one finds anything of library interest in an annual report (apart from the usual breath-taking statistics) but I see, from the annual report of the ASTM, that their *Bulletin* will be issued monthly instead of eight times a year, beginning in 1961. They call attention, too, to the increasing issue of their special technical publications (STP series) to the excellence of which I believe I have called attention before. As the essence of current thinking on particular subjects I consider them invaluable.

The American Society of Mechanical Engineers (29 West 39th Street, New York 18) now sells books of coupons to facilitate the purchase of their publications. The price of a book is $6 and this includes ten at five cents, 15 at 10 cents, 8 at 25 cents and 4 at 50 cents.

Hertfordshire's education programme is the envy of quite a number of authorities and its centre is, I suppose, Hatfield. The Technical College's 1960-61 programme is now available from Roe Green, Hatfield, complete with pretty pictures.

The Division of Building Research of the National Research Council of Canada (Ottawa) has produced an index of and list of its publications, 1947-1959. This is a healthy list and many of the items have application other than north of the 49th parallel.

Thank goodness I don't have to review stuff. It leaves one open to verbal abuse, questioning of opinion and sometimes the knife in the back. So all I have to do is mention that Aslib (3 Belgrave Square, London, SW1, remember?) have produced "Survey of Information/Library Units in Industrial and Commercial Organisations" at 10*s* to members and 12*s* 6*d* to outsiders (in the nicest sense).This is the result of chunks of figures and other guff collected by a former assistant director of Aslib (Dr. D. J. Campbell) and assembled for publication by the present head of research, C. W. Hanson. By the way, Campbell, one notices, is M.I.Inf.Sc. and Hanson is F.I.Inf.Sc. and if anybody wonders what this new qualification is that is creeping alongside folks' names it is the Institute of Information Scientists. Wonder if I ought to belong? Wonder if they'd have me?

Vectors to Precession

A Treatise on Gyrostatics and Rotational Motion. By ANDREW GRAY. *Dover Publications, New York; Constable, London.* (19*s* 6*d*)

Gray's well-known treatise on the dynamics of rotation, written over forty years ago, deals with the subject as it stood after receiving extensive development both for its own sake and in connection with mechanical theories of aether and matter. Since that time there has been little fundamentally new development of the theory, but the forces engendered by rotation have become an important consideration in the design and operation of high-speed rotating machinery, and the applications of gyroscopes, in control systems and instrumentation for example, have become widespread.

It is no exaggeration to say that a thorough understanding of these forces and of the behaviour of gyroscopic systems is essential for all mechanical engineers today. In view of this it is sad to have to record that the subject is understood properly by few, and that the behaviour of a simple gyrostat seems to the majority of engineering students to be explicable only by the processes of the black arts!

The difficulty of achieving an understanding of the subject was clearly appreciated by Gray, and his remarks on the matter are worth quoting. Although he did not use vector notation, except in passing mention, Gray noted in his preface that the method used by him was "one of calculating rates of growth of angular momentum for different axes, which amounts to a reduction to practice of vector ideas" and went on to say "It has been stated that all such methods merely amount in substance to the formal equations given in all the usual treatises, and no doubt that is true in a certain sense. Nevertheless, the criticism is pointless. There is a very important sense in which every process of a vector nature (whether it follow the notation of a vector analysis or not) differs from the usual equations: the former declares interpretations at every step to those who can read them, the latter does not. Thus, insight into mechanical action is fostered; a continual appeal to first principles accustoms the mind of the user to the application of fundamental ideas to all kinds of contrivances and in all circumstances. The perception of the action of more or less complicated gyrostatic or other dynamical devices becomes, in time and with the continual exercise of thought, intuitive when the processes are fundamental and interpretative; on the other hand, the traditional and scholastic method fosters the habit of reliance on the operation of a kind of machine of which the solver of the problem merely turns the handle. How to arrange the machine, what to feed into it and what to leave out, puzzles him at every change of application and environment."

These remarks have even more force for engineers today than they had when they were written, because the need for a sound physical understanding of these mechanical processes is greater, and because a well-developed flexible vector notation is now available. Physicists have long realised the importance of vector methods, and it is high time that vector calculus was considered to be an essential part of every course in mechanical engineering.

A great variety of topics is discussed by Gray: to give some idea of the scope of the treatise, the chapter headings include "The simpler theory of tops and gyrostats," "Gyrostats and various physical applications of gyrostats," "Vibrating systems of gyrostats . . ." "The motion of chains of gyrostatic links. Magneto-optic rotation," "The Earth as a top. Precession and nutation. Gyrostatic theory of the motion of the nodes of the Moon's orbit," "Effects of air friction and pressure. Boomerangs," "Dynamics of a moving frame containing a flywheel," "General dynamics of gyrostatic and cyclic systems," and "Analogy between a bent rod and the motion of a top. Whirling of shafts, chains, etc." Of course, a comprehensive treatise of this kind is not to be used as a text-book but rather as a book of reference, and as such it is still unsurpassed in its field.

The introductory chapter can be read with profit by non-mathematicians, but the subsequent chapters require a knowledge of differential equations and elementary kinematics and rigid-body dynamics. While it is not an easy book to read, the reward for a little trouble taken is great indeed. References to original papers are given in the text, and there is an adequate index.

G. N. WARD.

Fusion by Electric Shock

Exploding Wires: Based on a Conference on the Exploding Wire Phenomenon, April, 1959. Edited by WILLIAM G. CHACE and HOWARD K. MOORE. *Plenum Press, New York; Chapman and Hall, London.* (76*s*)

Practical aspects of using fusible wires for circuit protection have, of course, been exhaustively studied and the "exploded wire" technique for the spectroscopic analysis of metals is still used. But not until very recently has the fundamental mechanism of the rupture of metallic wire by passage of an intense current pulse been extensively investigated.

The widespread interest in both fundamental and practical aspects of this phenomenon is now evident by the publication of a book by Plenum Press called *Exploding Wires*. The book is primarily a record of papers presented at the "Conference on the Exploding Wire Phenomenon" organised by the Geophysics Research Directorate, Air Force Cambridge Research Centre in Boston Massachusetts, and edited by W. G. Chase and H. K. Moore. It is the first book in any language dealing with exploding wires and the increasing scientific importance of the subject is manifest from the scope and quality of the papers it contains.

The papers are twenty-five in number and are divided into three groups: Theoretical and Experimental (13 papers); Shock Waves (4 papers); and Applications and Technique (8 papers). Twenty-three are by workers in the United States, one paper is from Germany and one jointly French and German. No Russian papers are presented, but a survey of the bibliographies shows they are very active in this field.

The book is introduced by a short but excellent survey by W. G. Chase of exploding-wire research covering both earlier work and the contents of the papers. He notes that the first scientific account of the disintegration of fine wires by an electric current was as far back as 1774, by E. Nairne in the *Philosophical Transactions of the Royal Society*. Apart from a few important papers between the two World Wars by American, German and Japanese authors, scientific interest was not fully aroused until the 1950's, since when the general mechanism of the phenomenon has been elucidated.

The experimental technique followed by most workers is to explode the wire by connecting it to a charged capacitor through a suitable low impedance switch, and observing the time variations of current and voltage, the intensity and spectral composition of the light emitted or the nature of the shock waves produced in the surrounding medium. The time duration of the various phenomena are of the order of a few microseconds and the difficulties of the instrumentation can be gauged from the need to achieve time resolutions of a few millimicro-seconds.

Theoretical and experimental studies have

shown that the heating caused by the initial surge of current (less than one microsecond duration) rapidly raises the temperature of the wire to a value well above its vaporisation temperature, while inertia and magnetic pressure tend to maintain the physical shape of the wire. The material of the wire becomes superheated and vaporisation ensues with explosive violence. In the initial stages of the explosion, the wire changes from a continuous metallic conductor to a system of liquid droplets separated by metallic vapour. The conductivity falls by several orders of magnitude and with it the current, giving rise to the well-known "current pause."

Owing to the very high density and consequent short mean free path of the vapour at this stage of the explosion, the current cannot be maintained through ionisation by electron impact. Only in the later stages of the explosion is the density sufficiently reduced for ionisation by impact to occur, leading to arc formation and a second stage of current build-up.

The study of shock waves produced by the explosion is only now being undertaken and results so far suggest that this line is promising.

The book also discusses a number of possible new uses for the exploding wire phenomenon. Among these are the bonding of vitreous components such as quartz tubing, the provision of ultra-intense light sources for photochemical work and high-speed framing cameras, and the possibility of an exploding-wire plasma accelerator as a power source for rocket propulsion. An interesting paper on this subject suggests that plasmas derived from exploding wires may be accelerated to velocities of 8×10^6 cm per sec, compared with velocities of 3×10^5 cm per sec for present operational chemical systems. There is no paper dealing with the application of the exploding wire technique to spectroscopic analysis. This technique has much to recommend it in the detection of certain trace impurities in metal wires, for example thorium, calcium and aluminium in tungsten wire, and might be considered as a worthwhile subject for further research.

Although in effect a series of specialist articles, the book is readable as a whole. The editors are to be congratulated on the skill with which they have arranged the papers to maintain continuity of subject matter and avoid the worst effects of the inevitable diversity of styles. Diagrams, graphs and mathematical symbols are well presented. The photographs of apparatus and equipment are somewhat variable in quality but this shortcoming is perhaps unavoidable when their origins are so diverse. The volume unquestionably fills a gap in our technical literature and, although not quite in the textbook category, it is an essential for all those wishing to study the exploding wire phenomenon.

J. N. BOWTELL

Shipbuilding Responds to Its Environment

British Shipping. By R. H. THORNTON. 2nd Edition. *Cambridge University Press.* (21*s*)

Twenty years have elapsed between the two editions of this book, the first of which appeared in 1939 and was well received. The second is a worthy successor. These have been two decades of great change for the shipbuilding and the shipping industries.

The Second World War decimated the British mercantile marine, swung the emphasis of world shipbuilding more heavily than ever towards specialised tonnage, and presented on a new scale the problems raised by flags of convenience. Technical advance brought a continuation of the struggle between the motorship and the steamship and the first inklings of nuclear powered shipping. A new age of competition has grown rapidly as the aeroplane has developed its freight and passenger carrying potential.

It is therefore not surprising that the second edition, while preserving the framework of the first, has been substantially rewritten. It also provides an exercise in compression so far as the historical development of the British steamship industry is concerned. The first half of the book has been condensed to make room for a chapter covering the years 1945 to 1957 and the chapters dealing with the different aspects of shipbuilding, shipowning and shipping in their modern context are entirely new.

Having to deal with the technical and economic problems of shipping over the last two decades has added to the value of the historical section. A reading of this first section puts the industry's problems into perspective. The development of the 19th century steamship, its competition with sailing vessels, and early technical problems, especially boiler efficiency, are treated in a clear and penetrating fashion.

The reader is made aware that, great as may be the problems of the industry today, they were just as great and not dissimilar in kind for the pioneers of the iron steamships a century ago.

History repeats itself—though never in an idential pattern. It is as true of engineering development as it is of political history. The first half of this book gives an excellent account of how shrewd men with certain technical opportunities (and as always an unclear grasp of technical potentialities and limitations) made key decisions about investing in the new steam-raising techniques as applied to ships. Sometimes they were wrong, sometimes right. With a few unfortunate exceptions, those lost out who clung to old techniques too long, were victims of bad management, or who, like the gifted Brunel, created such technical prodigies as the Great Eastern, in which conception exceeded the means of putting it into practice.

The classic example of technical conservatism was the decision of the United States mercantile marine to hang on to sailing ships long after the steamship had won. These sailing ships—they include the famous Yankee clippers—were excellent craft. They were far superior (and had been for half a century) to their British competitors. They were technically still advancing—up a *cul-de-sac*. They were beaten by two considerations: a steamship could run a close scheduled series of voyages irrespective of wind, and a new generation of marine engineers were rapidly developing higher boiler efficiencies. These higher efficiencies allowed steamships to reduce the space for coal and therefore increase their capacity to carry paying load. The Americans never recovered the lost ground, except in war and with heavy subsidies, until the coming of the aeroplane.

Getting off to a good start helped by Government mail-carrying subsidies, the British steamship, tramp and liner alike, dominated the world's sea lanes until the First World War. It was a unique combination of free-trade economic philosophy and technical advance. It ended when war and economic nationalism took over. Now it was the turn of the British to be slow moving and conservative, although in fairness it has to be said that the First World War brought a new interest on the part of neutrals in maintaining a merchant navy, an interest which through the days of the Great Depression led straight to wholesale subsidisation and flag discrimination. The technical and economic struggle continues. The name of Cunard appears early in this book and today, after the book comes to an end, that company is still offering a confident challenge on the north Atlantic crossing, and also taking an interest in aviation.

The second part of the book is a description of the logistics of shipping in all its aspects. It is a major achievement of the author that he makes what might have been exceedingly dry material both informative and readable. There is in it obviously much first-hand information. Anyone who wishes to understand in outline the various aspects of ship management from Lloyd's underwriting to the technique of loading a cargo liner or a tramp will find it here. It is all the greater pity that the book has no index, for it is not least a useful work of reference.

The book as a whole is a remarkable combination of information, description and discussion on economic and technical points, enlivened with a certain amount of prejudice which is interestingly opinionated without being hidebound.

G. E. TEWSON

Laboratory Planning and Administration

Handbook of Industrial Research Management. Edited by CARL HEYEL. *Reinhold, New York: Chapman and Hall, London.* (96*s*)

When it has been decided by senior management to commence a research project, it is then necessary at research management level to undertake detailed planning, since research is a business to be managed as a business. Environment, facilities, leadership, morale must all be taken into account. Progressing is also important and should be given a foremost place in research administration. Budgetary estimating and control will be familiar to all those concerned with research administration but since practice differs so widely from company to company, discussion of any particular approach can only be of passing interest. The same applies to reporting procedure which must also be "tailored" to suit the needs of a given management set-up.

The *Handbook of Industrial Research Management* comprises 505 pages written by 33 American contributors to meet the needs of top management, directors of research and financial executives. It deals at very great length with the problems encountered in industrial research management, but few of the chapters "crystallise out," and much of its value is lost in an excessive use of words.

It is divided into five sections, namely Management Perspectives; Research Perspectives; Accounting, Control and Evaluation; Personnel Administration in Research; and Government Contracts. From these five viewpoints the authors survey the whole field of research management. The need for long-range and comprehensive planning in research and development is strongly emphasised and the methods used by some American companies are described in detail.

An evaluation of research projects can be gained by asking a number of critical questions. These questions are enumerated and are most interesting and revealing if applied to organisations nearer home. Basic research—should it be segregated from other types of research? This is an old question, but both points of view are given a hearing. Stimulation by management is very necessary, as of course is cross fertilisation: effective liaison within an organisation can improve its efficiency.

Continued on next page

Due to the tremendous volume of scientific literature published every year, information research is of increasing importance. A new profession is emerging—that of the information research worker. Esso Research have set up a technical information division "which would have information as its sole business," on a par with experimental divisions staffed by information research workers. The information researcher is a man of proven technical ability who is well known and highly regarded by both research workers generally and research management. He must be convinced of the importance of his work, and be able to convince people of the value of his information and ideas. This is a new approach to information research and well worth serious consideration.

Personnel administration in research—a most difficult field—is treated very expertly. The problems arising in recruiting, placing a man within the research organisation and planning his future are fully recognised and discussed. "Climate"—the factors influencing the effectiveness of the job—should be given special consideration. Training also plays an important part in a scientist's career, particularly in his earlier years as a research worker. Some attempt should be made to give him an understanding of human relationship problems and he should receive a certain amount of training in management. Opportunities for postgraduate studies should be readily granted.

There is an adequate index in this book but no bibliography. However, footnotes provide 46 references and there is a list of United States industrial research laboratories and government agencies which sponsor industrial research. It is interesting to read the biographical notes on the contributors, of the 33, 29 are mentioned as graduates, 12 are chemists or chemical engineers, 2 are physicists and the remainder are qualified in metallurgy, law, patents, accountancy, and so on. Eleven of the contributors are consultants and although there is no discernable bias towards chemical research in the book, the consultant approach is noticeable in many of the chapters. This bias is particularly apparent on re-reading the chapter on basic research by Dr. Kelly, who until 1959 was the chairman of the board of Bell Telephone Laboratories. His contribution is clear, concise and to the point.

The book succeeds in bringing within one cover a survey of current American practice in research administration, but since practice varies so much from one company to another, it necessarily contains some information which is of only passing interest. But certain fairly well defined patterns of research organisation have emerged over the past two decades and these are not presented as clearly as they might be.

It is doubtful whether many senior managers, directors of research or financial executives could spare the time to read such a lengthy volume. If it were condensed to two-thirds or even half of its length and more use made of tables of comparison, charts and graphs, its value would be greatly increased, and it would then become an extremely useful reference book.

D. E. P. JENKINS

New Books

Market Research on a European Scale: Paris Conference, 29 June-1 July, 1959. *European Productivity Council of the Organisation for European Economic Co-operation, Paris; HM Stationery Office, London.* (10*s* 6*d*)

At the conference organised by EPA in liaison with the International Chamber of Commerce and the European Society for Opinion Survey and Market Research, some hundred experts from sixteen countries considered how market research could be applied in the larger geographical concepts created by the Six and Seven.

Coke Burning Appliances. 6th Edition. *Gas Council, 1 Grosvenor Place, London, SW1.* (35*s*)

The domestic appliances included in this loose-leaf handbook are required to pass performance and/or dimensional and constructional standards before they are approved, laboratory tests being backed by "field" experience.

Railway Works Construction. By H. M. PEARSON. *Odhams Press.* (35*s*)

Written by a railway civil engineer of over thirty years' experience, this is a practical textbook intended for railway and contractors' staff use, and as a reference book.

Corrosion Problems of the Petroleum Industry. S.C.I. Monograph No. 10. *Society of Chemical Industry, 14 Belgrave Square, London, SW1.* (30*s*)

At the joint symposium organised by the Institute of Petroleum and the Corrosion and Chemical Engineering Groups of the Society of Chemical Industry, papers were presented on corrosion problems of production equipment, tankers, storage tanks and pipelines, and refineries.

Car Driving for Beginners. *Educational Productions Ltd. in Collaboration with the Association of RAC Registered Motor Schools and Driving Instructors.* (3*s* 6*d*)

A supplement to organised courses of driving instruction, telling how a car works, how to negotiate the main road hazards, and how to pass the test.

Power Stations Work Like This. By ROLT HAMMOND. *Phoenix House.* (9*s* 6*d*)

A book for young people on the generation, distribution and transmission of electricity.

Radio Aids to Civil Aviation. Edited by R. F. HANSFORD. *Heywood.* (126*s*)

Altogether 14 contributors from official and industrial organisations have collaborated to produce this work on aircraft communication systems, *en route* aids, air traffic control, approach, landing and surface movement aids, weather radar, and radar links.

Company Law. By H. GOITEIN. *English Universities Press.* (25*s*)

The object of this textbook is to provide a grounding in the principles of company law in a form that the student, whether of law, accountacy, administration or economics, can readily appreciate.

The Exploration of Space. Edited by ROBERT JASTROW. *Macmillan, New York and London.* (38*s* 6*d*)

The symposium on space physics sponsored by the National Academy of Sciences, the National Aeronautics and Space Administration and the American Physical Society in April, 1959, presented a survey of the most recent developments in the field, including papers on the Van Allen radiation belts and the Argus experiment.

Nationalised Industry and Public Ownership. By WILLIAM A. ROBSON. *Allen and Unwin.* (50*s*)

Fifteen years experience of nationalised industries give a wider perspective to an inquiry into their working than was possible in the two previous books written under Professor Robson's editorship. In this volume, which was written entirely by him, he considers the workings of the industries and, in a final chapter, the alternatives which have been advanced.

Anti-Corrosion Manual, 1960. *Corrosion Prevention and Control* (*Scientific Surveys Limited*), *97 Old Brompton Road, London, SW7.* (60*s*)

The third in a series of annual surveys of corrosion problems; resistant materials; protective coatings and preparatory treatments; painting, coating and packaging methods; water treatment; and cathodic protection.

Migrant Australia. By J. M. GILES. *Mills and Boon.* (12*s* 6*d*)

An introduction to Australia for Pommies, written by a Sydney journalist, and explaining some of "the little things that are omitted from the Government brochures."

Radioactive Wastes: Their Treatment and Disposal. Edited by J. C. COLLINS. *Spon.* (55*s*)

A group of experts has contributed articles on the nature of radioactivity, the sources of wastes, the hazards of radiation, radioactivity measurement, legislation on wastes, and the treatment and disposal of liquid effluents and solid wastes.

The Commonwealth and Europe. *Economist Intelligence Unit Ltd., 22 Ryder Street, St. James', London, SW1.* (42*s*)

One of the most intricate and important reasons for the failure so far to create a single European market with British participation is the need to reconcile the present system of Commonwealth trade with such a concept. This study of the problem was sponsored by Britain in Europe Limited.

The Aeroplane: An Historical Survey of its Origins and Development. By CHARLES H. GIBBS-SMITH. *HM Stationery Office.* (35*s*)

A very readable survey of the development of the aeroplane traced in detail from the earliest times to the present day, with a chronology of aviation, glossary, bibliography, and a detailed index.

Heat Transfer Engineering. By HILBERT SCHENCK, JR. *Longmans.* (28*s*)

Starting from the basic principles of the subject, the author deals in turn with each of the modes of thermal energy transfer; then discusses systems involving two or more of these mechanisms; and finally describes whole thermal systems comprising several components.

ASTM Manual for Rating Motor Fuels by Motor and Research Methods. 4th Edition. *American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.* ($7·50, *members* $6)

Standard methods of test for knock characteristics of motor fuels, together with appendices on apparatus, reference materials, operation and maintenance, and installation and assembly.

The Reviewers

Professor G. N. Ward, M.A., occupies the chair of mathematics at the College of Aeronautics, Cranfield.

Mr. J. N. Bowtell, B.Sc., A.Inst.P., is a member of the principal scientific staff at the Research Laboratories of the General Electric Company Limited, and is in charge of incandescent lamp research. He has also carried out research on fluorescent and other discharge lamps, electroluminescent devices and cathode-ray tubes, and is a member of the Illuminating Engineering Society.

Mr. G. E. Tewson, M.A., is a partner in the firm of O. W. Roskill Industrial Consultants.

Mr. D. E. P. Jenkins B.Sc., A.M.I.E.E. was until recently Divisional Administration Officer at the Research Laboratories of the General Electric Company Limited. He now holds a similar post at the Research Laboratories of the Morgan Crucible Company Limited.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Air

Centrifugal Fans. KEITH BLACKMAN LTD., Mill Mead Road, London, N17. Aerofoil section centrifugal fans from 1,000 to 50,000 cu. ft per minute and from 1 to 15 in w.g., described in 48 page two colour catalogue No. 37.

Air Conditioning. BRIGHTSIDE HEATING & ENGINEERING CO. LTD., PO Box 118, Sheffield 1. Air conditioning and treatment plant for factories and offices. Examples illustrated in 30 page booklet.

Aerofoil Fans. STURTEVANT ENGINEERING CO. LTD., Southern House, Cannon Street, London, EC4. Catalogue of BAVA centrifugal backward sloped aerofoil fans with capacities from 1,000 to 45,000 cu. ft per minute at pressures up to 5 in w.g. Dimensions and details.

Low Speed Fans. MIDLAND HEATING AND VENTILATING CO. LTD., Bedford Road, Birmingham 11. Gyra-flo low speed multiblade centrifugal fans covering discharges from 50 to 21,000 cu. ft per minute at pressures up to 3 in w.g. Description and details given in illustrated brochure.

Heavy Fan Engineering. KEITH BLACKMAN LTD., Mill Mead Road, London, N17. Publication No. 25 deals with heavy fan engineering and illustrates the Tornado range of centrifugal and axial fans, blowers, exhausters etc.

Forward Curved Centrifugal Fans. DAVIDSON & CO. LTD., Sirocco Works, Belfast, Northern Ireland. The range of Sirocco forward curved centrifugal fans, type LD, is described in 28 page booklet. Capacities from 1,350 to 84,000 cu. ft per minute. Selection and installation notes included.

Control Valves. STUART DAVIS LTD., Bayton Works, Bayton Road, Exhall, nr. Coventry. "Red Ring" control valves for compressed air systems. Hand and power operated with or without pilot control. Pressures up to 150 lb per sq. in. Leaflet.

Marketing

Norway's Output Rising Swiftly

An appreciable and rapid increase in industrial production in Norway, one of the United Kingdom's partners in the European Free Trade Association, is shown by the latest official Norwegian bulletin. The monthly production index from the bureau of statistics in Oslo indicates a 7 per cent rise in July's industrial output compared with the same month last year.

The export industries increased their output by 18 per cent.

Furnaces for the Export Markets

Keeping up well with the official enthusiasm for more exports are the WILD-BARFIELD ELECTRIC FURNACES Company of Watford, Hertfordshire. Among the export orders they are currently handling are more than 40 furnaces for customers in India. These orders range from large scale furnaces for production applications to small muffles for laboratory and technical school use.

A large high temperature furnace is to be produced for the Royal New Zealand Air Force and among export orders for Belgium is a Wild-Barfield crystal pulling furnace. Laboratory and toolroom equipment is also being produced for Canada.

Cooling Tower Contract for RTB New Steel Mill

RICHARD THOMAS AND BALDWINS have placed a contract for concrete natural draught water cooling towers for the power station, blast furnace and gas cleaning plants of their works now being built near Newport, Monmouthshire. The contract, valued at £240,000, is with FILM COOLING TOWERS (1925) of Richmond Surrey. Film Cooling Towers are also to produce two multi-cell induced draught water cooling towers for an oxygen plant being supplied by British Oxygen Engineering.

The Central Electricity Generating Board have placed a £550,000 contract with the company for three natural draught water cooling towers at their Richborough, Kent, power station.

Fords of Dagenham to Assemble in Italy

The Ford "Anglia" has had a considerable success in Britain even though unkind critics of its straight line design have referred to it as "anglier than thou." Now according to reports from France it is to be assembled inside the Common Market.

Ford is well placed in divided Europe with Ford Cologne inside the Six, and Ford Dagenham inside the Seven.

According to the reports, representatives of Ford Detroit and its European associates met recently in Rome to consider ways and means of tackling the European market. The Anglia was selected as the Ford model most likely to prove competitive against the Volkswagen, Dauphine, Fiat 600 and other cars in this class. The Germans are said to have been anxious to have Common Market production of the Anglia at Cologne. In the end however they were over-ruled and it was decided to build a new factory at Trieste to start assembling Anglias in 1961.

Why does Ford need a second establishment inside the Common Market? The answer is that although the Rome Treaty lays down a time-table for tariff cuts and quota enlargements the national governments are able to put various obstacles in the way of freer trade. Italy has been the most successful of the Six in setting up bottlenecks on the road to Rome.

Quota enlargement has gone very slowly and the basic tariff is both high and complex and after two cuts of 10 per cent is now 37 per cent for cars up to 1,500 c.c., 32 per cent for those of 1,500 c.c. to 4,000 c.c. and 29 per cent for cars over 4,000 c.c. entering Italy from the other Common Market countries. In addition imported cars pay an administrative tax of 1 per cent, a compensation tax of 4 per cent both of the c.i.f. value, and a turnover tax of 3 per cent of the duty paid value. There is also the fact that the Italians calculate the tariff on the c.i.f. value increased by 6 per cent. All told therefore the idea that German and French cars enter Italy at all freely is wide of the mark.

Strategic Siting

Any company wishing to set up inside the Six with a measure of protection during its first years could not do better than build its factory in Italy. Indeed the load of taxes carried by imported cars is not the whole of the story. Italian cars newly registered are allowed exemption from road tax for their first six months running. This concession is worth about £6 to the owner of a small car such as the "Anglia."

Why was Trieste chosen for this new venture? The report is that the idea of a site in the Mezzøgiorno was first contemplated because of the favourable terms given to new factories there by the authorities. In the end however it was decided that a port with established routes to Yugoslavia and the Middle East would be preferable. Also Trieste is in easy reach of the South of France, Austria, South Germany as well as the Italian market.

Although the new factory will concentrate on the Anglia, the small Taunus 12 M made by Ford Cologne will also be assembled. Production is expected to begin next year. This is a move that will be closely watched by manufacturers in Six and Seven alike.

New Solution for Old Athens Problem

The difficulty of accommodating a normal electrical substation in the narrow streets of the old quarters of Athens has been solved by SOUTH WALES SWITCHGEAR in the design of a new transformer.

The £1,500 transformer, designed and developed in the company's Blackwood works, near Pontllanfraith is to be delivered this Autumn to the ATHENS PIRAEUS ELECTRICITY Company. Weighing about a ton and a quarter the transformer will be installed below ground level. Only an air vent will show above the surface.

The transformer's oil-cooling system is entirely below ground level and will continue to function in the event of damage to the air duct.

Softly, Softly, Catchee Market

Britain has been replaced by Japan as the main overseas source of United States imports.

Imports from Japan in the first six months of 1960 were worth over $575 million, compared with $564 million from Britain. Both countries showed a rise on the previous year. But Japan's gains were much the more considerable, going up from $450 million, while Britain's rose from $547 million.

Several American industries and trade unions are beginning to register alarm at Japan's rapid progress. American glass manufacturers have protested against any further reduction in tariffs. These complaints have been lodged with the United States Tariff Commission which is now hearing testimony on a variety of American products affected by tariff or trade negotiations in the GATT and elsewhere.

Scientific glassware in particular is suffering from Japanese and to a less extent West German competition. The Tariff Commission has been told that American glass workers receive about $2·60 cents an hour compared with the Germans' 70 cents and the Japanese 20 to 30 cents. Some manufacturers of sheet glass have gone so far as to say that their industry will be destroyed within ten years if cheaper foreign products continue to enter the USA.

Ceramic companies are also complaining to the Tariff Commission. Imports from Japan have risen from 6·5 million sq. ft in 1958 to 15 million sq. ft last year according to one source. Other Japanese goods that entered the United States in increased quantities included bicycles, rubber footwear, cameras and transistor radio sets.

Worried About Boycotts

Apart from protests from industry, there have been moves to boycott Japanese goods in some parts of the USA. Indeed, it is true to say that the Japanese themselves are equally worried about their success. The Japan Export Trade Promotion Agency (JETRO), has been holding a series of conferences to assess the strength of American opinion against Japanese goods. A nationwide agitation to boycott some products would set Japanese industry back considerably. The sort of happenings that started the JETRO inquiry were the cancellation of orders for bicycles, Japanese foodstuffs and footwear by stores and supermarkets in various areas. The problems facing the Japanese is the unusual one of knowing how cheaply they can sell their goods without raising a stir from industry that will close the market against them.

Light Plane Plans for Australia

Preparations for the production in large numbers of an Australian designed light aircraft are going ahead in New South Wales. The light aircraft, the two-seat Millicer Air Tour, has been given a certificate of airworthiness. The company concerned are Victa Consolidated Industries.

Their £A4,000 aircraft has been conceived as a successor to the classic Tiger Moth. It is expected that the first Millicers will be taking the air in less than a year's time.

American General Motors Do Well in France

The French division of the American GENERAL MOTORS Company, whose main product is refrigerators, increased its net profit last year by almost a quarter over 1958. The turnover for the company was 22 per cent better than in 1958.

Daily output of refrigerating equipment was 832 units, four units a day below the previous year's figure. The target for 1960 is 1,000 units a day. Exports from the refrigerator section, where manufacture is under a United States license, improved by 98 per cent. A 120 per cent increase in exports took place in the company's vehicle parts although its sales in France improved only by 18 per cent.

Tito at British Zagreb Pavilion

President Tito, touring the 51st Zagreb International Trade Fair, made his longest stop on the British Pavilion at the MASSEY FERGUSON potato harvester. The Yugoslav leader heard the company's representative describe how the harvester can take up sort and clean the potatoes from two and a half acres of land in the time that would be taken by 30 agricultural workers.

An important contribution to the use of mechanised equipment on Yugoslav farms has been played by Massey Ferguson. Since 1955 the company have obtained contracts worth £18 million in Yugoslavia.

A German Share in Saharan Exploration

Two French oil exploration companies, SAFREP and FRANCAREP, have signed an agreement with two West German firms, PREUSSISCHE BERGWERKS UND BUETTEN and WINTERSHALL. The work which the four companies will tackle together is in exploitation of a permit awarded to Safrep two years ago. The two German companies will each have a 25 per cent interest, Safrep a 40 per cent share, and Francarep the remainder.

Within the area of its Tan Emellel permit, another French company, EURAREP, which is also associated with a German company has struck oil and natural gas at 1,350 and 1,420 metres.

Australian Natural Gas into Electricity

The natural gas flow in Australia, which is not yet harnessed to industrial uses, may before long be used for electricity generation. Quantities of the gas have broken through the surface of the ground after drilling operations in Queensland, rising at one bore at 3·5 million cubic feet a day.

Proposals are in the air for piping the gas to a power station. It has been estimated that the use of the escaping natural gas could produce electricity equal to Queensland's present output.

Pipe Branch Connections

The British Welding Research Association has completed some work on the design of reinforcements for pipe branch connections. Knowledge of the stresses in these connections should lead to more economical reinforcement.

By P. H. R. Lane, B.Sc.(Eng.)
British Welding Research Association

VERY few, if any, strain measurements on the inside surfaces of pipe branch connections have been made in the past. Everett and MacCutchan[1] tested branch connections under internal pressure in which the branch was the same size as the main. They used strain gauges on the outside surface only but deduced that there would be high stresses at the crotch of the specimen on the inside surface. Greene[2] carried out bending tests, but his results are not comparable with those obtained in the present investigation. Blair[3] carried out tests under internal pressure, and bending in the plane of the specimen. He proposed a formula for failure under internal pressure.

Most mathematical work on this type of problem has been based on a hole in a flat plate. While this is quite satisfactory for pressure vessel conditions, where the size ratio of branch to shell is small, the assumptions are not applicable to pipe branches where this ratio is large. The only mathematical work applicable to pipe branches is for very thick pipes.

SPECIMENS

Seven fabricated connections, five of them reinforced, were tested, together with three seamless welding T's. Each of the fabricated specimens consisted of a length of pipe with one branch. With one exception (specimen 2) they all had branch and main of the same dimensions, i.e. 10·56 in outside diameter and 0·65 in thick. The pipes were machined to secure a uniform thickness, and to provide a good finish for attachment of wire resistance strain gauges. The specimens were stress relieved on completion of welding.

Specimen 1 was unreinforced. After welding, the profile of the inside of the joint was dressed with grinding wheels and emery bands to give as nearly a geometrically true intersection as possible. On the outside the weld was dressed so that it followed the correct profile, but instead of a sharp junction, which would have been difficult to produce uniformly, the intersection between the branch and the main was finished with $\frac{1}{4}$ in radius. Specimen 2 was also unreinforced, but in this case the ratio between the branch pipe and the main pipe was 5 : 6. The ratio of thickness to diameter for each pipe was the same as for all the other specimens tested.

Specimen 3 was reinforced with a collar $4\frac{1}{4}$ in wide and $\frac{1}{4}$ in thick. The conventional rule for reinforcement allows credit for some arbitrary length of the branch pipe as part of the reinforcement. It is then required that the total area of reinforcement, provided by reinforcing plate and part of the branch pipe, shall be not less than the area of material removed from the main, viewed on a longitudinal section. According to this rule, specimen 3 would have been slightly over-reinforced, since the collar itself provided a replacement for all the material cut out of the main. Specimen 4 was provided with a collar $2\frac{1}{4}$ in wide by $\frac{1}{4}$ in thick. Again disregarding any contribution from the branch pipe, it provided a replacement of 37 per cent of the material cut out from the main. Specimen 5 had a collar of unusually heavy proportions. The design of this reinforcement was guided by two considerations: firstly, on a longitudinal section the area of the collar should be equal to the area of metal cut out from the main; secondly, it was thought that good results might be obtained from a collar which had the largest practicable moment of inertia.

Specimen 6 was reinforced with a "triform," the type of reinforcement proposed by Blair as a result of his investigations.

The final two specimens (7 and 8) each had a collar of the same dimensions as that of specimen 4, but in each case this was augmented by a strap encircling the main only. In specimen 7 the major dimension of this encircling strap was perpendicular to the main, and in specimen 8 it had its major dimension parallel to the axis of the main.

The welding T's were substantially in accordance with BS 1640. They would have been suitable for use with 8 in Schedule 80 pipe; their main dimensions are shown in Fig. 1.

TESTS

Five types of loading were applied to the specimens, as follows (see Fig. 2):

(*a*) Axial load on branch pipe,
(*b*) Bending of the branch in the plane of the specimen (in-plane bending),
(*c*) Bending of the branch in a plane perpendicular to that of the specimen (out-of-plane bending),
(*d*) Twisting moment on the branch piece, and
(*e*) Internal pressure.

In the tests in which axial loads or bending moments were applied to the branch pipe, the deflections of the specimens were measured. The deflections in test (*d*) were so small that simple equipment was not sufficiently accurate to measure them.

Strains on both surfaces of the specimens were measured by means of wire resistance strain gauges. Along the axes of symmetry, pairs of perpendicular straight gauges were used; away from these axes it was necessary to use rosette gauges. As far as possible, the gauges on the inside surface were directly opposite those on the outside.

RESULTS

Deflections.—For each of the tests in which deflections were measured, load/deflection curves were substantially straight lines.

To provide a ready means of assessing the influence of the various branch connections on deflections, an "equivalent extra length" has been calculated for each. The results of the calculations are shown in Table I, where a negative value indicates that the deflection was less than that calculated for an unpierced straight pipe similarly loaded. For out-of-plane bending, the value is negligible for all specimens.

The equivalent extra length is the difference between the actual length of the appropriate part of the specimen, and the length which would be calculated by a simple beam formula to give, for the same maximum bending moment, the same deflection as was measured in the actual specimen. It should thus be related to the branch connection as such, and be independent of the lengths of the component pipes.

Stresses.—All the readings of the strain gauges gave load/strain or pressure/strain curves which were substantially linear. The greatest departure from linearity was a strain of approximately 20×10^{-6} which is equivalent to a stress of 0·27 ton per sq. in.

It was found that for each form of loading the maximum stress was, with one exception, in the same location for all the specimens. These locations are incorporated in Fig. 2.

Figs. 3 and 4 show the stress distribution diagrams for specimen 1 for the two forms of loading giving the highest stresses. The general trends of the corresponding diagrams for all specimens were very similar.

In Table II the maximum stresses are presented

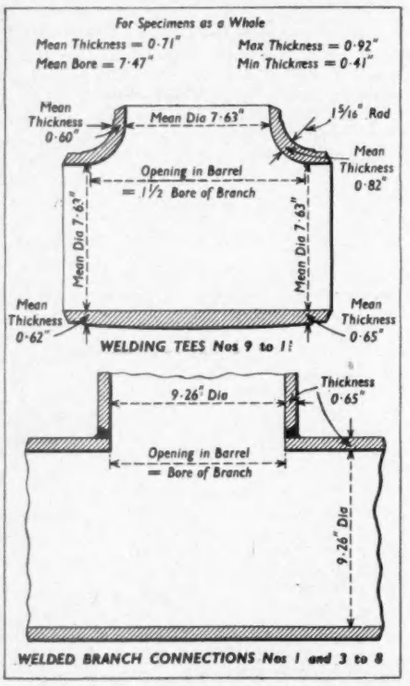

For Specimens as a Whole
Mean Thickness = 0·71"
Mean Bore = 7·47"
Max Thickness = 0·92"
Min Thickness = 0·41"
Mean Thickness 0·60"
Mean Dia 7·63"
1 5/16" Rad
Mean Thickness 0·82"
Opening in Barrel = 1½ Bore of Branch
Mean Dia 7·63"
Mean Dia 7·63"
Mean Thickness 0·62"
Mean Thickness 0·65"
WELDING TEES Nos 9 to 11
9·26" Dia
Thickness 0·65"
Opening in Barrel = Bore of Branch
9·26" Dia
WELDED BRANCH CONNECTIONS Nos 1 and 3 to 8

Fig. 1 The main dimensions of the welding T's.

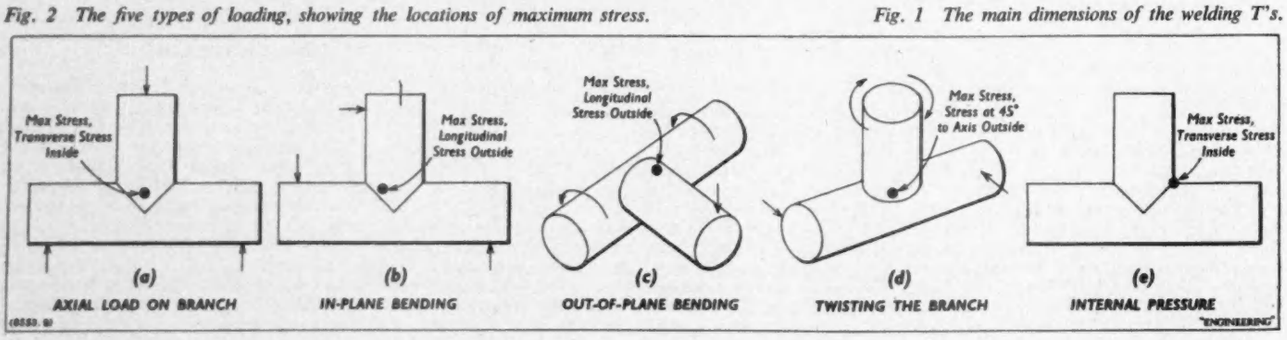


Fig. 2 The five types of loading, showing the locations of maximum stress.

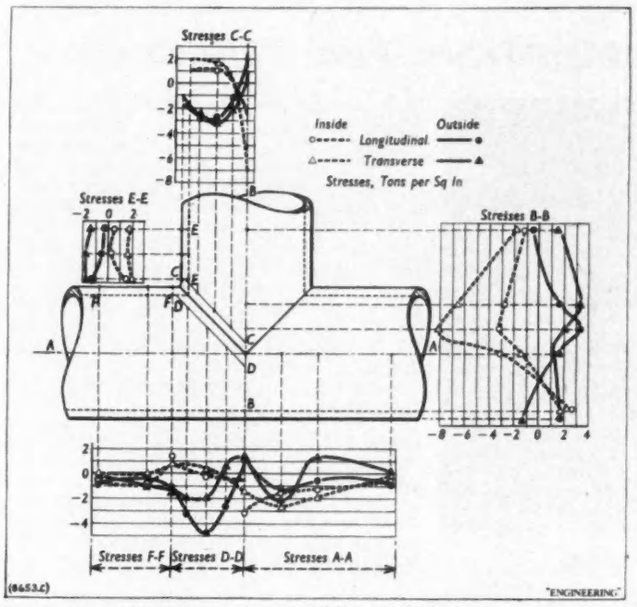


Fig. 3 Stress distribution with an axial load on the branch.

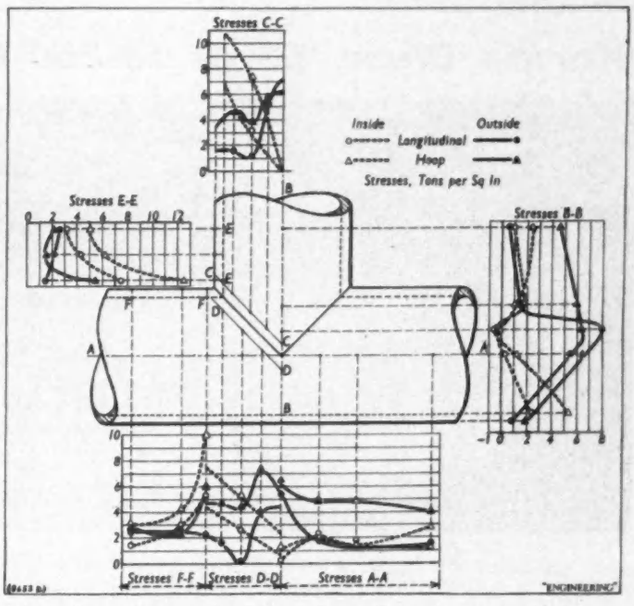


Fig. 4 Stress distribution under internal pressure.

in the form of stress intensification factors. These are the ratios between the maximum measured stress for a particular form of loading, and a stress which can be calculated by one of the simple beam formulae or, for internal pressure, by the mean diameter formula.

DISCUSSION

The "equivalent extra lengths" are all small compared with the normal lengths of pipe run which would be associated with such branch connections. Even without reinforcement, the equivalent extra length is only 19 in for the equal branch specimen and 24 in for the specimen which had a 10 in branch on a 12 in main. All types of reinforcement effected some improvement on this figure, and the presence of internal pressure further reduced the flexibility.

Table II shows that, for all the fabricated connections except specimens 7 and 8, the highest stress intensification factors were found either for an axial load on the branch or for internal pressure. The stress distributions for these forms of loading were similar. The in-plane or out-of-plane bending tests and the test in which twisting moments were applied to the branch, consistently gave lower stress intensification factors. Even in specimen 7, in which out-of-plane bending gave a slightly higher stress intensification factor than axial load on the branch, the difference between these two is small.

Table II also indicates that those reinforcements which reduced the stress intensification factor for one type of loading were also effective for the others. This is subject to some exceptions, notably in the case of specimen 5. This collar led to a considerable reduction in the stress intensification factor in the case of axial load on the branch, but only a slight reduction was obtained in the case of internal pressure.

With an axial load on the branch, the stress intensification in the welding T is lower than in any of the fabricated connections, except in specimen 6. For in-plane bending also, the welding T's show stresses as low as the best of the reinforcements. For twisting the branch, the stress in the welding T is higher than any of the reinforced connections, but still somewhat lower than the unreinforced connection.

For internal pressure, the welding T shows a higher stress intensification factor than the unreinforced fabricated connection which, in turn, showed a higher value than the reinforced specimens. In considering this high value, attention should be paid to two factors. First, there is a smooth transition between the branch and main in the welding T, and it should be possible to place a strain gauge exactly at the point of maximum stress. The maximum stress in the welded connection is close to the junction between branch and main, and this limits the accuracy with which it can be measured. Therefore, even if the stress distributions in the two types of specimen were identical, a higher value would be measured on the welding T than on the welded connection. The second fact, which may actually *cause* a higher stress in the welding T is that, owing to the transition between the branch and main, the effective opening in the main is rather larger for the welding T than for the welded connection. (See Fig. 1.)

In considering the stress intensification factors shown in Table II, it must be borne in mind that it is not necessary to attempt to reduce the stress intensification factor to unity. Though present day design stresses are based on tensile strength, with the materials commonly used the effect is that they are never greater than approximately two-thirds of the yield point of the material. Thus a stress intensification factor of 2 can safely be permitted without any danger of repeated reversed yielding.[4]

It was thought that there might be some

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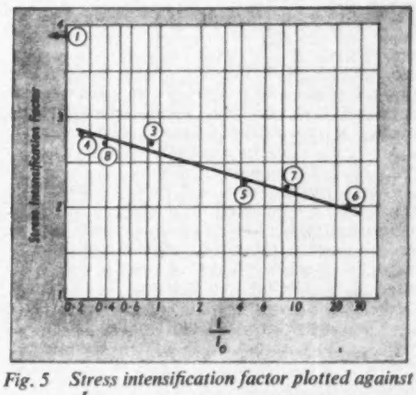


Fig. 5 Stress intensification factor plotted against $\frac{I}{I_0}$ for axial loads on the branch.

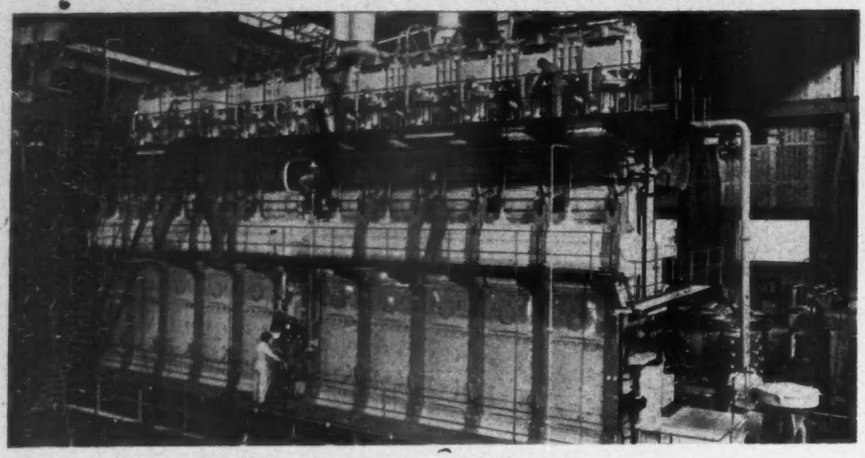
TABLE I:—*Equivalent Extra Lengths*

Specimen No.	Reinforcement	Equivalent extra lengths, in	
		Axial load on branch	In-plane bending of branch
1	Nil	19	2
2	Nil	24	13
3	4½ × ⅜ in collar	8	−2
4	2 × ⅛ in collar	13	−1
5	1⅜ × 1⅛ in collar	7	−5
6	"Triform"	10	−1
7	2 × ⅛ in collar and 2½ × 1 in radial girth strap	10	2
8	2 × ⅛ in collar and 2 × ⅛ in flat girth strap	9	1

TABLE II:—*Stress Intensification Factors*

Specimen	Reinforcement	Stress intensification factors					Reinforcement data	
		Axial load on branch	In-plane bending of branch	Out-of-plane bending of branch	Twisting of branch	Internal pressure	Moment of inertia, in⁴	Weight, lb
1	Nil	3·9	2·2	3·3	3·5	3·6	0	0
2	Nil Branch: Main: : 5: 6	3·3	1·8	—	1·9	3·6	0	0
3	4½ × ⅜ in collar	2·7	1·7	2·2	1·9	2·2	0·184	55
4	2 × ⅛ in collar	2·8	2·0	—	1·9	2·5	0·056	24
5	1⅜ × 1⅛ in collar	2·3	1·4	—	1·1	3·1	0·912	49
6	"Triform"	2·0	1·6	—	1·1	2·2	5·19	66
7	2 × ⅛ in collar and 2½ × 1 in radial girth strap	2·2	1·7	2·4	2·2	2·5	1·79	40
8	2 × ⅛ in collar and 2 × ⅛ in flat girth strap	2·7	1·9	3·1	1·9	2·8	0·084	30
—	Welding T	2·7	1·4	—	2·8	4·9	—	—

Marine Diesel Gives 18,350 b.h.p. from Ten Cylinders



10-cylinder 18,350 b.h.p. marine diesel engine during shop running trials.

The first unit of a 10-cylinder turbo-charged marine diesel engine of a new design has been undergoing shop running trials prior to installation in a new vessel. Designed and built by Aktiebolaget Götaverken, Gothenburg, Sweden, it is claimed to be the highest powered marine diesel engine ever built.

The engine is to be fitted in a 40,000 ton tanker now being built for the Salén Lines of Stockholm by Öresundsvarvet, Landskrona, Sweden, a Götaverken subsidiary. It is at present rated for an output of 18,350 b.h.p. (21,700 i.h.p.) at 115 r.p.m. and an indicated mean pressure of 8·8 kg per sq. cm (125 lb per sq. in). Bore and stroke are 850 mm (33·5 in) and 1,700 mm (67 in) respectively.

Though contracted for the above rating, the engine has actually been dimensioned for an indicated mean pressure of about 10 kg per sq. cm (142 lb per sq. cm). When sufficient experience has been gained from the tests the mean pressure for the new type of engine may be brought up to this level by increasing the amount of turbo-charge, which would raise the output to 21,200 b.h.p.

Nylon Bonding in Sun and Planet Gear

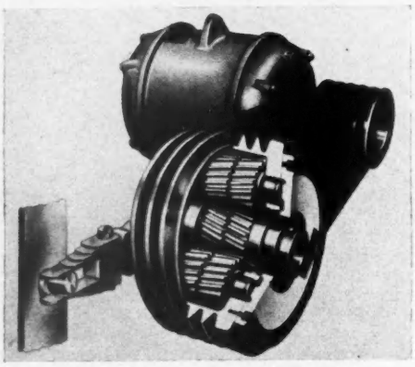
The problem with sun and planet gears is one of lining up so that each planet takes its fair share of the load. The speed reduction units produced by Andantex Limited, Manchester 11, incorporate a patent assembly method in which the planets are bonded by nylon.

In the system used, the planet pinions are mounted on their shafts and left free to rotate. On preassembly of the unit, the pinions take up their natural positions, equally loaded. Special adaptors used in place of the planet shaft bearings permit this pre-loading. The assembly in this state forms a mould which is preheated and liquid nylon is injected from a press. On cooling, the adaptors are removed and the correct bearings are inserted, taking up their position in the nylon matrix.

The units themselves are intended for applications calling for a compact speed reducer for direct mounting on to the driven shaft of a machine. An example is illustrated. All gears are of the single helical type made from nickel-chrome steel, hardened and profile ground; only ball or roller bearings are used. Immobilisation of one of the sun gears is normally carried out by the use of a standard torque arm—a simple casting fitted with leaf springs.

The reduction units can act as a safety device for driven equipment. When fitted with the standard torque arm, the unit is protected by the leaf springs, which will fail at 100 per cent overload above normal rating. If for some reason the unit is subjected to more severe overloading, the nylon bonding within the unit will shear, thereby releasing the drive without damage either to the gears or to the capital equipment being driven. The nylon bonding can be renewed at the company's works.

The units are self-contained, the case being used as an oil bath and the whole sealed by high-duty oil seals. Various sizes are made, to transmit loads up to 36,000 lb-ft. Some 21 set ratios are available, ranging from 2·79 : 1 to 273 : 1 where the driven shaft rotates in the same direction as the driving shaft; and from 1·79 : 1 to 272 : 1 when the driven shaft rotation is opposite to that of the driving shaft.



Concluding **Pipe Branch Connections**

relationship between stress intensification factor and the moment of inertia of the cross-section of the reinforcement. Table II gives, for each reinforcement, the value of the sum of the moments of inertia of the portions shown on a longitudinal section calculated for an axis through the centre of area of the portion and parallel to the axis of the main. Fig. 5 shows, for the case of axial loads on the branch, the stress intensification factor plotted against the ratio between the moment of inertia of the reinforcement calculated as above (I), and the moment of inertia of the portion removed from the main, calculated on a similar basis (I_o). It can be seen that there is a remarkably close correlation, especially when one considers the wide range of shapes of reinforcement represented.

The correlation, however is only empirical, and it has not been shown that it would hold for specimens of different proportions from those examined, or with different types of reinforcement. The quantities related do, however, have some physical significance, and this may indicate a profitable future line of investigation. No similar correlation was found for other forms of loading.

CONCLUSIONS

1 The influence of fabricated branch connections on the flexibility of piping systems is small and may generally be ignored.

2 The forms of loading giving generally the highest stress intensification factors are axial load on the branch and internal pressure. For the welding T's the highest factors are obtained for twisting the branch and internal pressure.

3 Reinforcements which are effective in reducing the stress intensification factor under one form of loading are usually effective under other forms of loading.

4 For axial loads on the branch and in-plane bending of the branch, the stress intensification factors found in the welding T's are as low as those found in any of the reinforced welded branch connections. For twisting the branch, the stress intensification factor for the welding T is intermediate between that of an unreinforced welded branch connection and that for a reinforced connection. For internal pressure, the maximum stress intensification factor in the welding T is higher than for the unreinforced welded branch connection.

5 For an axial load on the branch, there appears to be an empirical relation between the maximum stress intensification factor and the ratio of the moment of inertia of the longitudinal section of the reinforcement to that of the same section of the removed portion.

Acknowledgements.—The author acknowledges the help he has received from a committee of the BWRA under the chairmanship of Mr. E. P. S. Gardner, also from Dr. H. G. Taylor, former director of research, and Dr. A. A. Wells, assistant director. The author is also indebted to Messrs. R. F.Quartermaine, G. Higgins, D. R. Stonebridge, E. O. Lawrance, H. R. Bowen, and J. Turner, and Miss R. C. Thomson, all of whom have given assistance.

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Even Smaller American Cars?

After about 12 months of rumours that Ford Motor Company, Michigan, were designing a new car for the US market, smaller than their present compact and competitive with the Volkswagen, the company themselves have taken steps to make their feelings on the subject more explicit. The statement they have released boils down to saying they are sitting on the fence, keeping on their toes, waiting to see which way the cat jumps—if such a posture can be envisaged.

" For competitive reasons," state Ford, " we normally decline to discuss rumours about future product plans, but we feel that continued silence on our part could be interpreted as unqualified confirmation of this report." The specific report referred to was probably the one that not only was a Volkswagen type car to be produced, but it was to be manufactured in Germany. The statement in fact added, " As to our future course, we will continue to work closely with our foreign affiliates on the broadest basis possible. . . ."

The company pointed out that although they would continue to sell the products of Ford of England and Ford of Germany in the United States, future levels of such imports would of necessity be governed by demand. " We contributed to the recent drop in demand for imported cars by developing the Falcon and the Comet. These cars were designed specifically to compete with imported vehicles. They have accomplished this purpose extremely well: the Falcon and Comet have outsold all foreign imports so far in 1960. Their share of American car sales rose steadily while the sales of imports were going down."

The company goes on to say that they consider it impossible to forecast accurately the sales potential of cars smaller than the Comet or Falcon, but that they merit close observation.

" The Ford Motor Company has been studying the possibilities here carefully. We have given serious consideration to ways in which we might use United States facilities and employees for at least a substantial part of the work involved in producing and offering to the American consumer small vehicles of the type produced by our foreign affiliates. When and if such a course becomes feasible, we hope to be in a position to adopt it. Whether it will become feasible remains to be seen."

Meanwhile, Volkswagen are doing very nicely in the American market. Whereas the number of imported cars sold dropped in the first six months of 1960 by 6 per cent compared with 1959, the figure goes up to 15 per cent if Volkswagen sales are excluded from both years.

A new version of the Volkswagen has been put on the market recently. It looks just like the old models—the company explain that the body is functional and does not date—but has a number of changes in the engine. Power has been raised from 36 to 40 b.h.p. and the gearbox now has synchromesh for all four speeds. The compression ratio has gone up from 6 : 1 to 7 : 1, but higher grade fuel does not have to be used. Marked improvement in economy is claimed as a result of the new carburettor.

Edmonton Transit Steps on the Propane

Cars—as well as cookers—can run on butane or propane. Experiments are now going on in Canada to find out the best way of using these gases instead of petrol or diesel oil. Some have been successful, others have not.

Edmonton Transit System operate some 30 per cent of their fleet on propane. When the vehicles were converted for dual-fuel operation, at about 75 per cent diesel oil and 25 per cent propane, engine power at 30 m.p.h. was increased from 55 to 103 h.p. Other Alberta fleet operators have not been so fortunate, and have experienced a number of running problems when using propane. It has been suggested that many of these have been due to such things as mechanical defects, variations in running temperatures, and faulty compression ratios. One of the chief disadvantages of the gaseous fuels is the fire risk.

Mr. H. A. Spencer, Research Council of Alberta, described some of the work being done on gaseous fuels to the annual meeting at Winnipeg of the Engineering Institute of Canada. He saw several advantages in the use of propane or butane: higher power, longer engine life, and low mileage costs. Butane, a 100 octane fuel, is suitable for conventional car engines. Propane rates at 130 octane and can be used in engines with compression ratios of 16 : 1.

Two methods of using butane in conventional engines are available. The fuel can be cooled into liquid state and used with a normal petrol carburettor. Or the butane can be vaporised under controlled conditions of temperature and pressure, allowing accurate gas-air mixtures.

Propane, by the high compression ratios it permits, can give more efficient engines. It can be used in converted petrol engines whose compression ratios have been raised above 8 : 1, and in converted diesel engines that have been fitted with an ignition system. Alternatively propane can be used as a fuel additive in diesel engines. The diesel ignition supplies the start of combustion and the propane provides controllable power through a carburettor system.

Mr. Spencer suggested that air pollution would be reduced as a result of switching to propane. " On the diesel side," he said, " many complaints from cities about smog have been voiced. When a diesel accelerates, extra fuel is pumped into the nozzles and is not burned effectively until the engine reaches proper speed. Propane burns so much more readily that its addition has the possible advantage of overcoming the acceleration smoke ".

New BMC Station Wagons

The Austin A 55 Cambridge Countryman and Morris Oxford Traveller follow the conventional pattern, inasmuch as use is made of the pressings of the corresponding saloon models as far as possible, but there are some interesting design details.

The rear seats of these models, fold away in the usual manner to form a flat floor for extra freight, with the backrest stowed vertically behind the front seats; but, with the front seats slid forward to the limits of their adjustment, an extended floor can be made, giving a space 6 ft long by over 4 ft wide, with an upholstered pillow at the forward end. This arrangement, the equivalent of a double-bed size sleeping compartment, is achieved by splitting the backrest horizontally and mounting it on a sub-frame which swings forward. Half of the backrest then becomes the floor extension and the other half forms the pillow.

Austin A 55 Cambridge Countryman.

The spare wheel is carried in a cradle below the floor, held by a screw jack worked by the starting handle. It is not necessary to remove all luggage to obtain access to the tools. The last four inches of the floor lifts to disclose a shallow locker which contains the tools, starting handle and electric petrol pump.

The Austin version has separate front seats; the Morris has a single bench. At the rear, both models have a drop-down tail gate and a lift-up rear window. They are Farina-styled developments of Cambridge and Oxford saloons.

The Morris Mini-Traveller and Austin Seven Countryman are station wagons derived from the recently-introduced vans, with their wheelbase 4 in longer than the saloon models. The structure is all steel, with the usual sub-frames carrying the power unit, front suspension and front drive on one, and rear suspenison on the other; but for some reason it has been thought necessary to burden these lively little cars with much non-functional wooden decoration which experience shows will deteriorate long before the sheet-metal parts.

The mix in the rubber suspension units is different from that in the saloons, to cope with the greater weights involved. Front ends, doors and grilles are identical with the saloon models but the body behind the doors is longer and there are sliding side windows. At the rear are two vertical doors with check stays to hold them when open. With all four seats occupied there is 18½ cu. ft of freight space, which is increased to 35½ cu. ft when the rear seat is folded away. Use of front-wheel drive permits a loading platform only 14 in from the ground. Engine and transmission ratios are the same as on the saloons. The spare-wheel and battery are carried in a well below the rear floor.

Many improvements in detail have been made in the saloon models of these cars during their first year. The method of assembly of the body shell has been changed to cure extensive leaks into the floor from the sills and to give a neater finish round the windscreen. The roof rain gutters have been given flanged undersides to keep rain out of the tops of the doors. In addition, the body sealing is much more thorough. Sliding window latches are dowelled to holes in the glass to prevent them working loose. Changes have also been made to the clutch oil-sealing and shock-absorber mountings.

Morris Mini-Traveller.

Linking the World by Radio and Cable

Communication by radio, television and telephone is often taken for granted; but behind lie complex engineering systems. In Britain, these technologies are largely pioneered by the GPO.

TECHNIQUES for increasing the capacity, reliability and quality of our long-distance communications networks are being developed and studied by several teams at the GPO Research Station, Dollis Hill, London. At the same time brand new techniques, such as artificial Earth satellites, which could relay radio signals around the globe, are being carefully looked into.

Improvements on present-day techniques have ensured that all forseeable requirements for long-distance telephone and television transmission can be met in Britain for at least another decade. In spite of this, however, advanced study groups at the Research Station are investigating the potentialities of developments, such as tubular waveguides, which could increase our present capacity well beyond expected needs.

BRITISH LINKS

Although years of research and development may be needed before the tubular waveguide can replace today's coaxial cable, such effort will not be in vain if, for example, a cross-channel waveguide could be used to link Britain with the Continent. Such a waveguide could probably carry up to 100 television programmes or 100,000 telephone channels. Subscriber dialling to many European countries would also be feasible.

It is quite possible that underwater repeaters would not be required for such a cross-channel waveguide, because the signal-carrying efficiency of the tubular waveguide may be high enough for satisfactory performance without boosting.

As there are many problems to be solved before long-distance waveguides can be expected to compete economically with the established methods, the GPO have decided to avoid needless repetition of experimental work. They are therefore concentrating their efforts on studies not already known to be in progress in other laboratories, either in Britain or abroad. Thus, while most laboratories are concentrating on pulse-code modulation, endeavours are being made at Dollis Hill to find a way round the known limitations of a frequency-modulated waveguide system. Similarly, in the work on waveguide structures, methods of improving performance by modifying the surface impedance are being examined. This method is considerably simpler than those known to be in development in other centres, such as the helically wound waveguide.

It is intended, during the next few years, to link the British Commonwealth by an underwater telephone cable laid all round the world. The first section of it, between Scotland and Nova Scotia, will be laid next year. This cable will have a length of about 2,100 nautical miles and a cable loss which is approximately proportional to the square root of the frequency. At the highest signal frequency used on this route the cable loss will be about 5,000 decibels.

The loss at all transmitted frequencies is to be compensated in this cable by 89 submerged repeaters. At the output of every repeater along the route the cumulative difference between the cable loss and repeater gain must be the same to within $\pm$ 3 db. To meet this requirement, submerged equalisers will be inserted in the cable between successive blocks of twelve repeaters and their associated cable. These equalisers will each contain a fixed unit which compensates for the known difference between the loss of twelve repeater sections of the cable and the gain of twelve repeaters, and facilities for inserting a variable unit to compensate for second order differences and cumulative errors between cable loss and repeater gain. During cable laying measurements will be taken between ship and shore, from which the error at any block end may be calculated. This error will then be used to design an equaliser network which will be assembled on board ship and inserted in the next equaliser to be laid.

When a submerged cable has been laid it may be under a water pressure of some 3 tons per sq. in, and at a temperature of 3° C. These ambient conditions differ from those in the cable-factory tanks, where electrical measurements have to be made before cutting the cable into lengths of about 26 nautical miles to form repeater sections of the cable.

It is necessary to know the temperature and pressure coefficients of attenuation before a correction can be made to the factory-tank tests to determine the attenuation as laid. Since the laid attenuation must be known to 0·15 per cent accuracy and the temperature and pressure coefficients of attenuation are of the order of 0·2 per cent per °C and 0·5 per cent per 1,000 fathoms, these coefficients must be determined very accurately if the laid cable is to have the required loss characteristic. The apparatus developed at Dollis Hill for this work comprises a pressure vessel which contains a test length of cable under pressures of up to 5 tons per sq. in, at any temperature in the range 2·5° to 25° C. The electrical connections to the cable are made through a gland designed on the same basic principles as the type used in submerged repeaters.

NEW VALVE TECHNIQUE

A new valve, to be known as type 8P, has been developed at Dollis Hill to meet the all-important requirement of increased band width on submarine telephone cables. This valve has a figure of merit of about 1·0, which has been achieved by raising the mutual conductance to about 24 mA/V.

By the development of a new technique of grid construction, these valves have been given a high slope and low amplification factor; which means that they can function at a H.T. voltage of about 45 volts. The construction method uses an integral grid-1/grid-2 frame structure, which enables the clearance between grids to be kept down to a minimum (about 75 microns). It is conceivable that this new structure technique could be of value in other engineering applications where high-slope low

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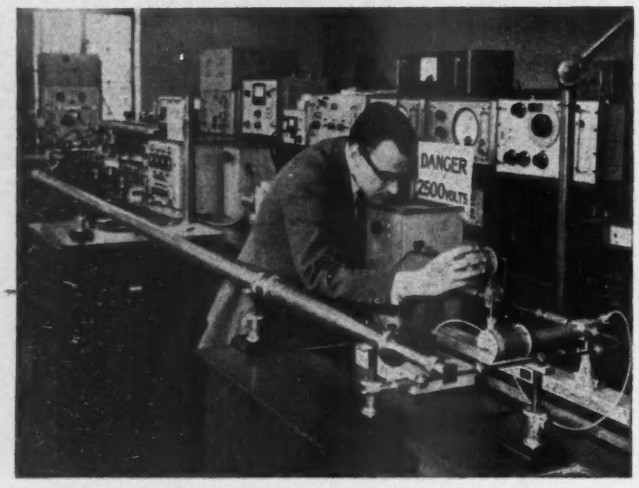
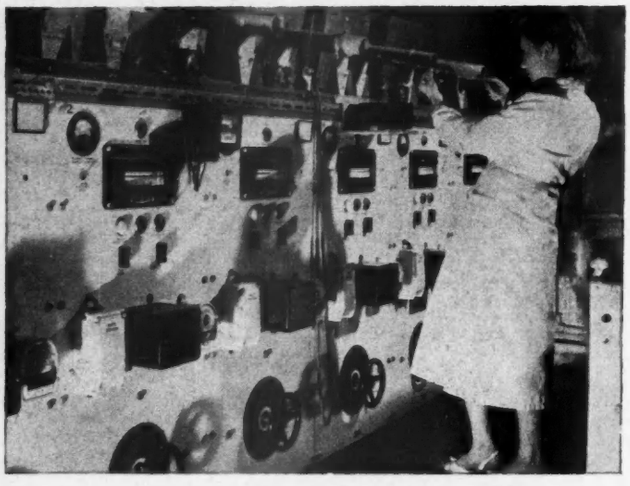
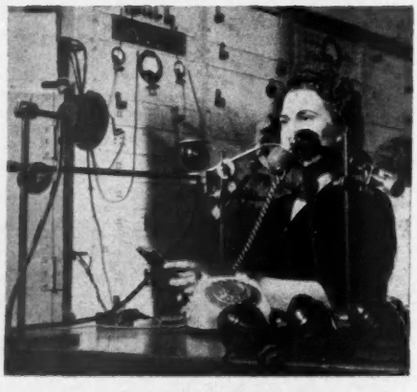


Current research on v.h.f. transmission along tubular wave guides may lead to considerable savings in cost and greatly increased capacity for long-distance communication.



Amplifying valves used in submarine telephone cables must have high life expectancy. These valves are made at the Dollis Hill laboratories, where special care eliminates impurities.



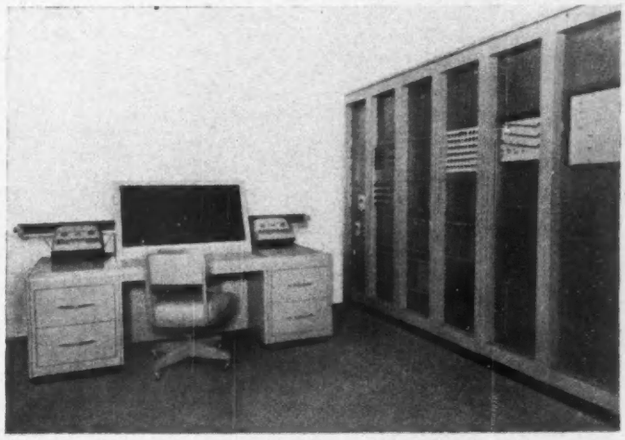
A new design of telephone is being tested in the laboratory for loudness and clarity.

Flexible Data Handling Unit for Industry

The accumulation of data representing physical conditions in any plant of a complex nature is nowadays considered essential if accurate and reliable records are to be obtained of operating costs, materials used, plant performance and safety conditions. Past experience has shown that human observation tires quickly under the arduous, complex, and sometimes monotonous task of manually recording large number of measurements, so that unreliable records are inevitable.

Excessive delay and inaccuracy occurs when such records are eventually evaluated and little reliance can be placed upon any conclusions drawn from them. An automatic system for the high speed collection of measurements and the presentation of these measurements in simple digital form is therefore desirable; but such a system must be entirely reliable.

Against a background of developing data processing equipment for many industries, Hagan Controls Limited have now developed the Kybernetes Data Handling System. This new system will provide the user with equipment capable of operating with maximum on-line availability and will perform logging, scanning, computing, programming and optimising operations in a flexible unit.



The new Hagan data handling system uses pin-board programming, and is able to perform logging, scanning, computing, programming and optimising operations.

Some features of the Hagan system are as follow: Pin board programming, which provides flexibility in choice of scale factor, zero suppression, linearisation, square root extraction, point omission, high and low alarm setting and computation. The use of specially designed amplifiers immune to "ground loops," mains frequency ripple and high frequency noise, which simplify installation and ensure accuracy of measurement. Analogue-to-digital conversion by a high speed electronic digitiser. Input signals can be low or high a.c., d.c. or pulsed. Maintenance is facilitated by the use of automatic self-checking routines and plug-in components. Automatic period logging facilities are available at prescribed intervals of 5, 10, 15, 30 and 60 minutes, continuous or single log cycle. Push buttons instantaneoulsy provide "on-demand" logs, trend logs, start and stop, visual, digital display and alarm log. Alarm detection by digital comparison provides accuracy of 0·1 per cent or 1 digit.

Importance of Space Research

The advantages to research in radio propagation afforded by space vehicles have been referred to in the recently published annual report of the DSIR's Radio Research Station. The Radio Research Board states that "rockets and satellites offer new ways of pursuing and extending the fields of research in which the organisation has specialised in the past."

They point out that the opportunities afforded by satellites for observing the earth's atmosphere, especially the ionosphere and its effect on radio wave-propagation, should assist the Station's experiments. In fact, they suggest that the Radio Research Station should design instruments for inclusion in US Scout satellites to be launched in the next two years, as part of the British space research programme.

In the immediate future, 50 per cent of the Station's effort will be devoted to this research. The provision of a radio telescope is expected to assist in research on reception techniques, and to make available a powerful tool for the extension of propagation research in several directions. The board comments that "The potentialities of terrestrial communications and navigation via satellites (and later, space communications) should be examined as part of the research programme."

Among the subjects discussed in the annual report of the director, Dr. R. L. Smith-Rose, was the Station's recent work on the prediction of satellite orbits. The Station has improved its facilities for positional measurements on satellites, and has extended its service of providing predictions of their orbits.

Over one hundred establishments and observers receive these predictions at weekly intervals. Observations on the transmissions from satellites are also being used in studies of the ionosphere. The World Data Centre for rockets and satellites established at the Station in October, 1958, is fulfilling its intended purpose of collecting data on space research and exchanging it with the two other centres located in Washington and Moscow.

Infra-Red Gas Analyser

Chemical engineers at the Atomic Energy Authority's Capenhurst Establishment have recently completed some important work on infra-red absorptiometers and other equipment using infra-red rays, to detect, measure and analyse. One of the instruments they have been working on is a non-dispersive infra-red gas analyser.

Originally developed to measure small concentrations of hydrogen fluoride in gaseous uranium hexafluoride, the instrument has been adapted to measure water vapour in air. It has a limiting sensitivity of about 10 microns partial pressure. Sample absorption is measured by comparing transmitted intensity at the absorption wavelength with that at an adjacent absorption-free wavelength. Appropriate wavelength bands are selected by interference filters inserted alternately into the optical system at a frequency of 2 c/s.

The resulting depth of the modulation is then a function of the sample absorption.

The optical path is also interrupted at 1,000 c/s by a toothed wheel so that the detector receives a doubly-modulated beam. The detector and amplifier channel system is self-adjusting in gain to produce a constant level of 1,000 c/s signal. The 2 c/s component of this signal is thus directly related to sample absorption and is filtered, rectified and displayed at the output meter.

The use of a single optical path and the method of signal handling makes the instrument largely self-compensating for changes in source intensity or sample tube transmission and for minor changes in instrument parameters.

Further information is available from the Patents Exploitation Officer, UK Atomic Energy Authority, 11 Charles II Street, London, SW1.

Concluding **Linking the World by Radio and Cable**

H.T. valves are required, although there is some doubt as to whether it would lend itself to the mass production techniques normally employed in valve making.

Low noise amplification is now of fundamental importance to modern long-distance radio communications, where microwave frequencies are always used. For future techniques, such as tropospheric scatter and artificial Earth satellite systems, the problem will be even more significant.

A number of experimental low-noise amplifiers have therefore been developed by the Post Office research engineers, using the parametric principle. One of these has been designed to precede the normal receiver of an 876·5 Mc/s tropospheric-scatter system. This amplifier is of the negative resistance type using a single variable-capacitance diode. It has a klystron oscillator working at about 4,000 Mc/s to provide the pump power. The idler circuit is a cavity resonator and there are separate coaxial input and output ports for the signal circuit.

History was made recently when a similar amplifier, tuned to 960 Mc/s, was successfully used to receive signals transmitted from the United States via the "passive" Earth satellite ECHO 1.

Designed to Help

THE human body is a complicated machine and like a machine it sometimes breaks down. It can also suffer damage and loss of members and a great deal of ingenuity and engineering knowledge has gone into producing substitute parts. The study of bio-engineering as a special science is young as yet, but already it has made big strides. In these days of manpower shortage it is arrant waste not to use a good brain or a skilful pair of hands just because the legs may no longer function well.

To make a chair with wheels is a comparatively easy task but to make one that enables its occupant to do useful work at the factory or even around the house requires the exercise of skill. A design that reached the market earlier this year is the Anderson Workachair, made by H. Anderson, West Hampstead Mews, London, NW6, and shown in the illustrations.

The Workachair for use in factory and home was developed from a Dexion prototype.

Important considerations with a working chair are that it is easily manoeuvrable around the benches and even more so in the narrower confines of the house; that the seat is a convenient height for working and that it is sufficiently rigid to form a good foundation from which to perform normal tasks. The prototype, built in Dexion angle, shows how the dimensions of the finished product were chosen. This prototype has a hydraulic pump at the back that enables the seat to be raised and lowered to find the most comfortable working height for each job.

The seat height of the Workachair is the same as that of a normal dining chair so that it can be wheeled under the table or bench allowing the occupant to reach comfortably over the working surface. Such a height also allows most people to bend forward and reach the floor. The framework is so constructed that the seat, back, footrest and arms can be raised by 10in, giving a height equivalent to a standing position or to one of the very tall bank stools. The raising is carried out by a hydraulic jack operated either by electricity or by a hand lever within reach of the occupant.

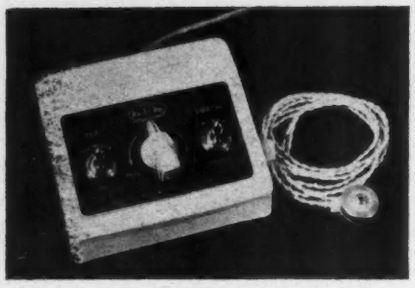
The wheels run in double ball bearings and have solid cushion tyres to enable them to roll easily over most floor surfaces. The safety castors obviate any risk of the chair overturning, and allow it to turn in its own length. The whole chair is of tubular construction so the weight has been kept down. This is an important aspect when the user has to be carried up and down stairs in the chair. One armrest is made removable so that movement from chair to bed or to another chair is made easier. The same armrest can also be drawn forward clear of the wheel and swung down to form a small table where books (or a teacup) can be placed.

Dunlop foam rubber has been used for the upholstery, covered in coloured pvc. As a result, the whole chair is washable. The standard model measures 40 in high and 24 in wide over the hub caps. The seat height from the footrest is 16 in and from the floor in the lowered position 19 in. Either 20 or 22 in wheels can be fitted. Apart from the standard model modified versions can be made for special cases.

Two improved devices have been produced to assist the hard of hearing. A new hearing-aid telephone now available has a small transistorised amplifier fitted in the handset of a standard GPO instrument; volume is controlled by a finger wheel fitted on the earpiece. Apart from its original purpose, the unit would seem to have some possible scope in telephones situated in particularly noisy areas.

The second device is shown below. It is a redesigned unit, by Electric Ades Limited, 4 Eastbourne Road, Hanwell, Middlesex, for giving remote control of radio programmes for deaf folk. The control box is connected to the sound output of the set and the user's own earpiece plugged in. Control is provided for volume and tone enabling the user to enjoy a programme without interfering with other occupants of the room. It is suggested that stethoscope earphones could be plugged into the box so that a single individual could enjoy watching television without causing any disturbance to others from the sound.

For armchair listening to the radio the Rai-Tel-Ade uses a standard deaf aid earpiece.



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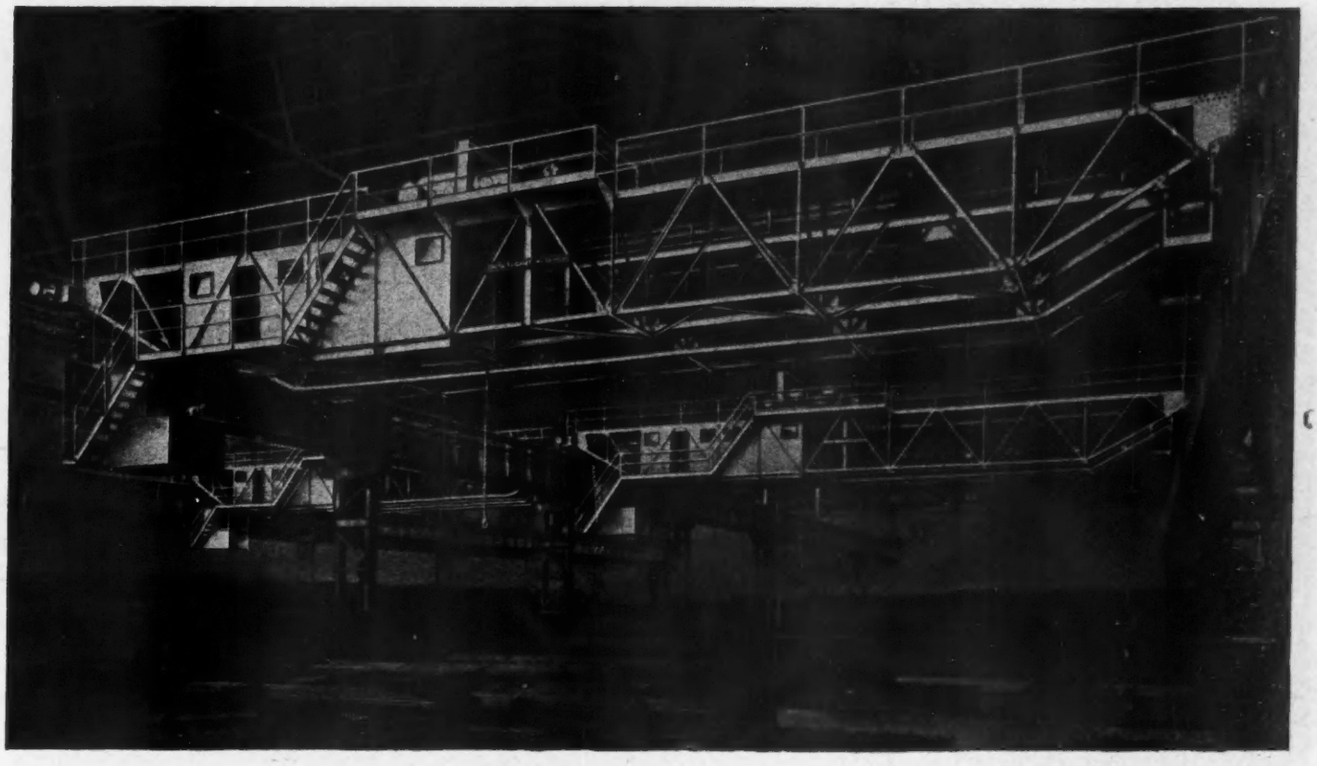

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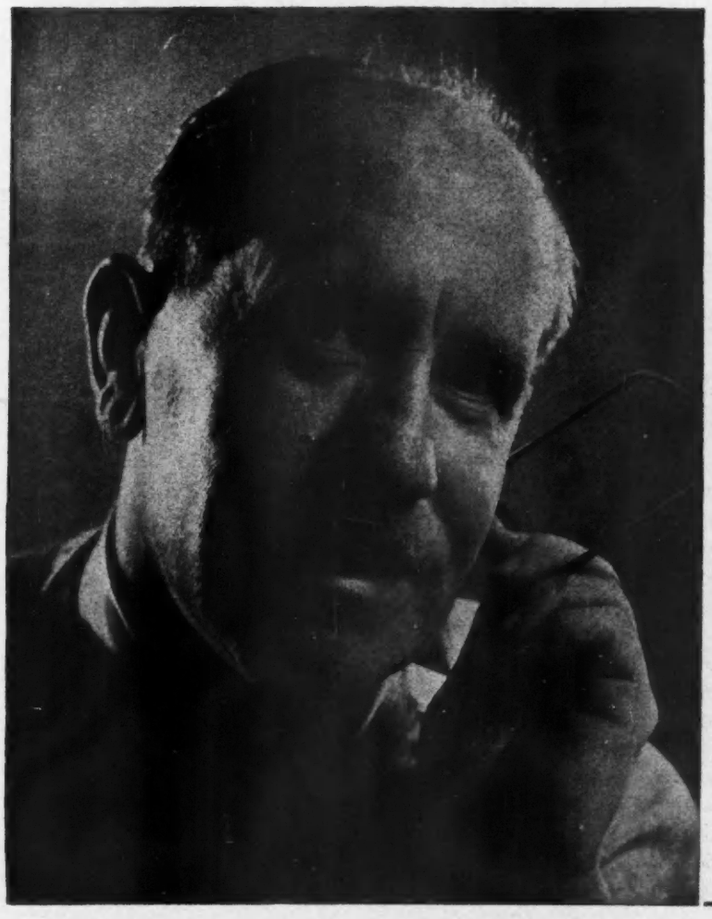

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H

Britain's new steelmaking processes set challenge to steel men

THE next ten years will be decisive for the future of Britain's steel industry. New methods are being developed which will change the established pattern of steelmaking. It is an exciting—and challenging—time.

The big new factor is oxygen. Ordinary oxygen from the air we breathe, but used as a pure gas, *by the ton*. In making steel it removes impurities more quickly and more cheaply than has ever been possible before.

New oxygen-making plant is being set up alongside the major steel works to deliver the gas along pipelines. About 3,000 tons of oxygen a day will soon be available.

Output: a 100% boost

Dr. Colclough, technical adviser to the British Iron and Steel Federation, has been a crusader for oxygen for 20 years. The great change that is making his vision practicable is that oxygen by the ton ("tonnage oxygen") is now available at a reasonable price.

FEDERATION'S COLCLOUGH
Crusader for oxygen

Dr. Colclough believes that, in Britain, oxygen can be used with greatest effect in the open hearth process, by which 85% of our steel is made. He says, "There is no question but that in the next ten years we shall see a revolution in open hearth steelmaking." Already, at the Appleby-Frodingham works in Lincolnshire, the open hearth furnaces converted to the Ajax process, using oxygen, have achieved outputs of up to 100% above those of conventional furnaces.

"The industry has gone a long way to solving the problems of using tonnage oxygen," says Dr. Colclough, "and many major steel developments of the future will be based on this principle. And by equipping the new oxygen-using plants with dust and smoke eliminators we are reducing the amount of air pollution caused by steelmaking."

New furnace, new methods

Another enthusiast for oxygen – though using it in quite a different way – is Mr. Emrys Davies, Works Director of Brymbo Steelworks in North Wales, which pioneered the large-scale use of oxygen.

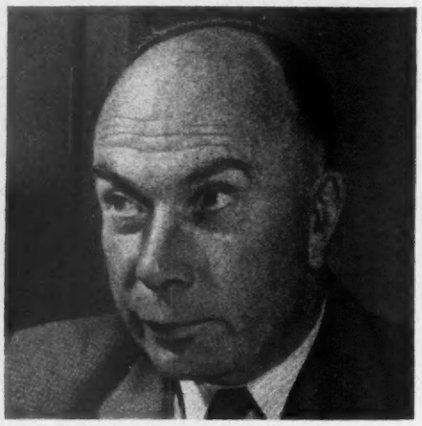
At Brymbo, after the war, they had a blast-furnace (for making iron) and some old open hearth furnaces (for turning the iron into steel). They were also making high-quality steels in electric arc-furnaces, mainly from scrap – because iron from a blast-furnace is much too impure to put into an arc-furnace.

They wanted to go over entirely to electric steelmaking. But it looked as though this would mean that they couldn't use the iron from their blast-furnace at all. Mr. Davies and his team developed an oxygen-blown furnace of wholly new design, to pre-refine blast-furnace iron before it went to the electric arc-furnaces.

Here are the makings of another revolution – because electric steelmakers have been chiefly dependent on supplies of scrap. Reducing this dependence could be very important – so much so that steelmakers as far afield as Japan are extremely interested in what is going on at Brymbo.

Less power, more steel

This completely new process has been embodied, daringly, in a £2 million development scheme, now proving its worth in full production. It has cut the time taken for the arc-furnaces to refine a charge of metal. It has reduced the electric power needed to refine a ton of steel from 650 units to 400 (quite important, when you consider that the Brymbo melting shop uses 10 times as much power as the whole of the nearby town of Wrexham). Outputs are up *at least 25%* – "a very conservative figure," according to Mr. Davies.



BRYMBO'S DAVIES
Steel at the cross-roads

Molten metal pours from the new Brymbo furnace, pre-refined with oxygen. This is one of the new developments which are bringing a revolution in steelmaking.

And whereas a Bessemer converter needs re-lining with special bricks after being used 80 to 100 times, the Brymbo pre-refining furnace has already been used 1,000 times. It has produced 25,000 tons of steel and will probably produce 10,000 more before re-lining is needed.

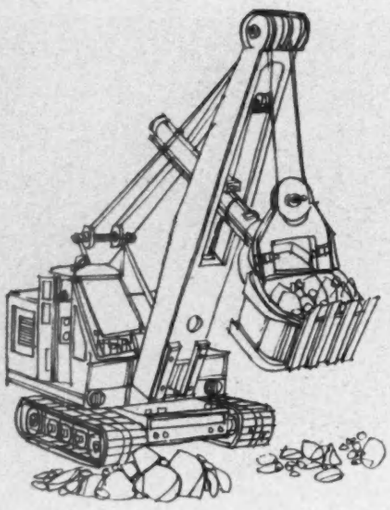
Most important of all, perhaps, the Brymbo process has signposted one possible way ahead for the whole industry: pre-refining can be applied just as successfully to open hearth working. "Steel is at a cross-roads," says Mr. Davies. "The next decade of steelmaking will probably be the most interesting for 100 years. Great developments are taking place."

Oxygen is coming into its own, taking its place alongside iron ore, coke, and limestone, as a basic raw material in steelmaking. Already Britain's steel men can see that it brings higher output and lower costs. It will mean an all-round improvement of efficiency in Britain's already highly efficient steel industry.

This report on progress in oxygen steelmaking forms part of the "Autumn report to the Nation" published in the press by the British Iron and Steel Federation.

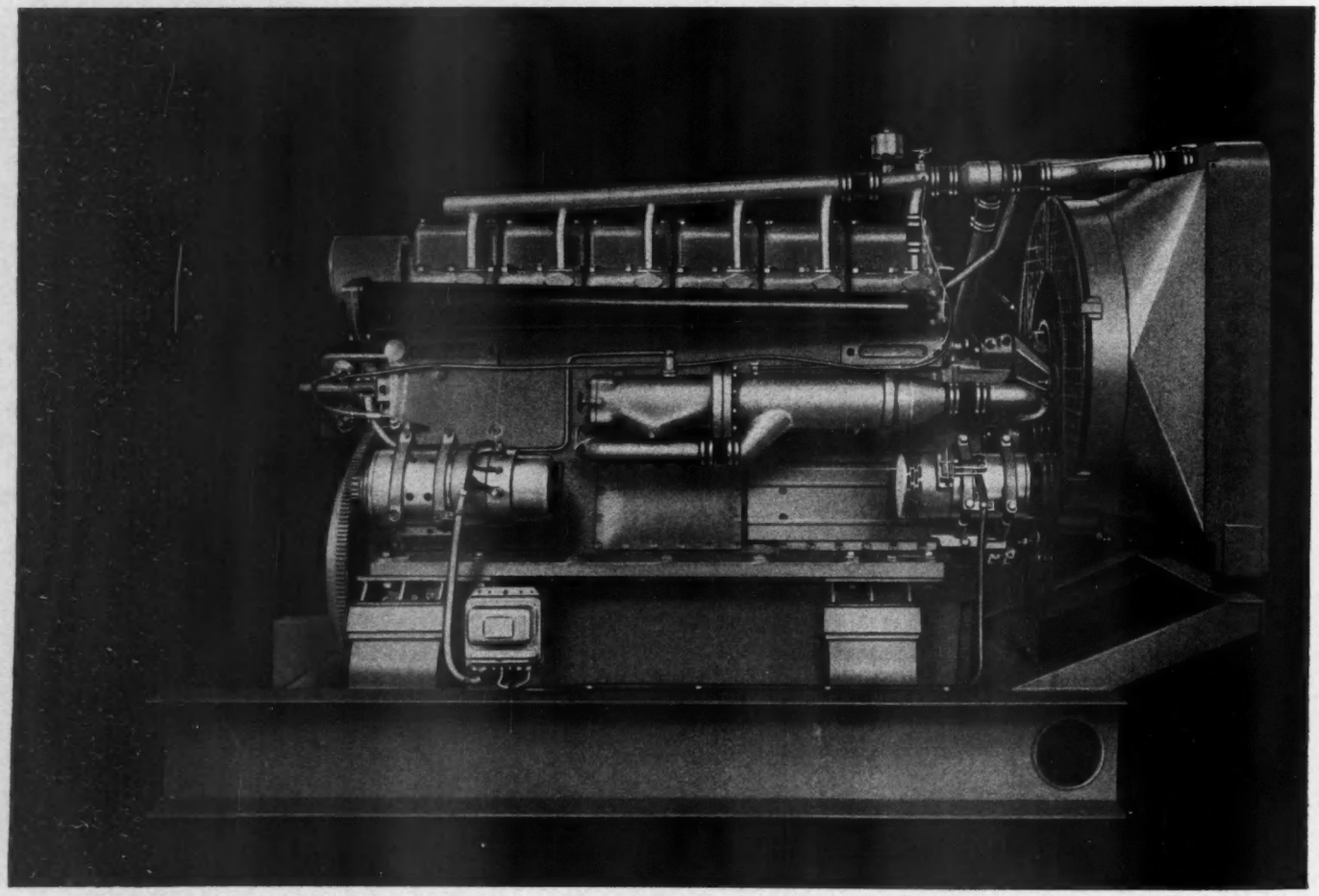
084 MAe

How many H.P. are required?



Industry needs engines of every size – for generating electricity, for compressors and pumps, for cranes, excavators, fork lift trucks or industrial locomotives.

No matter whether only 20 PS or several thousand PS are required Daimler-Benz can satisfy the demand with their range of Diesels designed to supply the right engine for every use in industry and commerce. 34 different types of Diesel engines are available ranging from 20 to 3000 PS. All are high speed Diesels with the advantage of compactness and low weight, valuable attributes particularly for mobile power units. Economy is another feature of Mercedes-Benz Diesel engines. Fuel consumption is modest and servicing easy and what is more, owing to their robust construction they give years of service with constant high performance.



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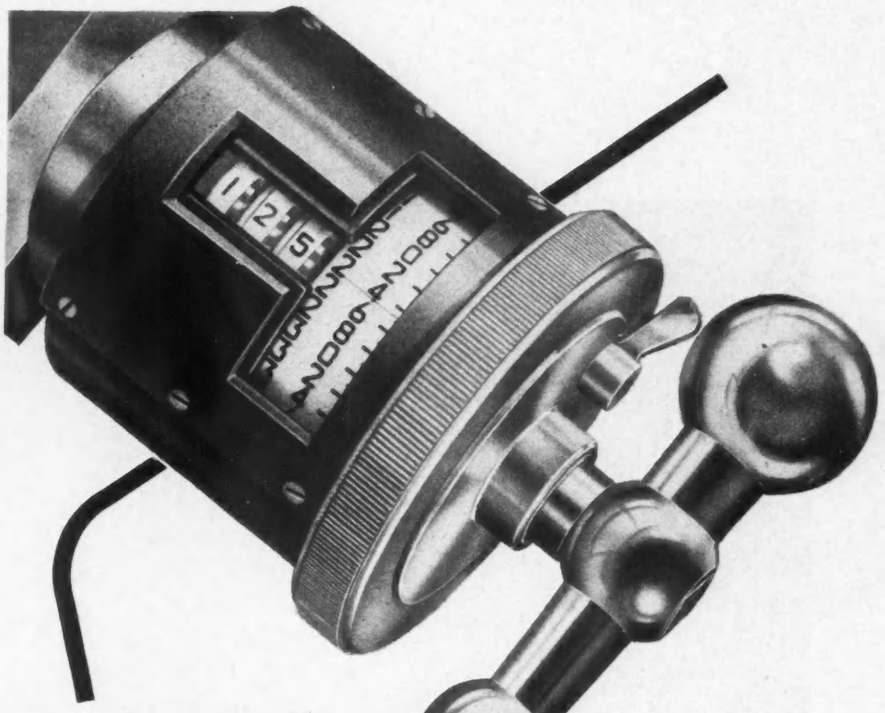

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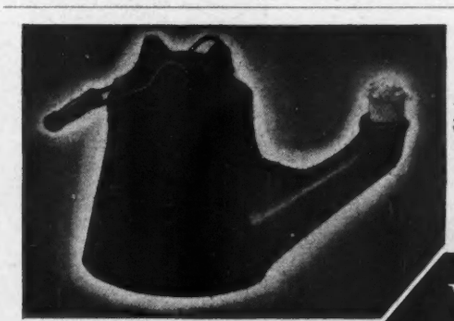

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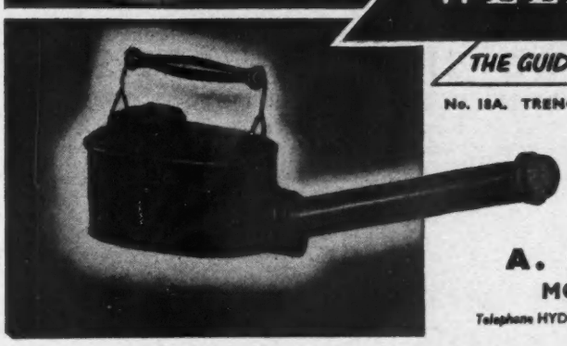

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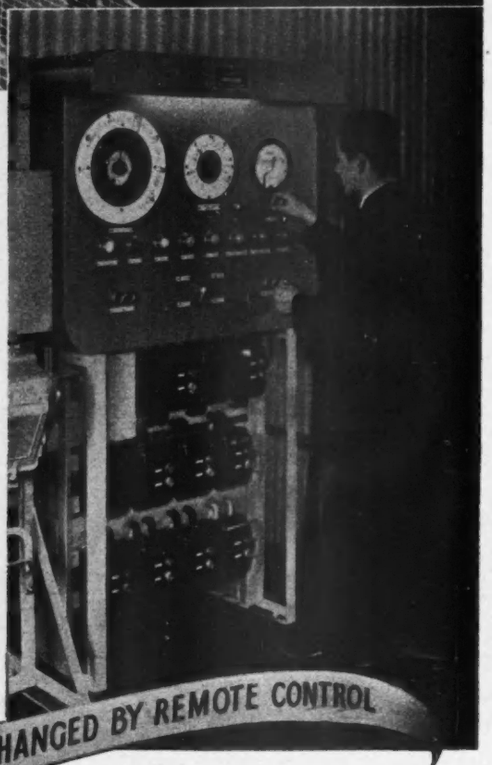

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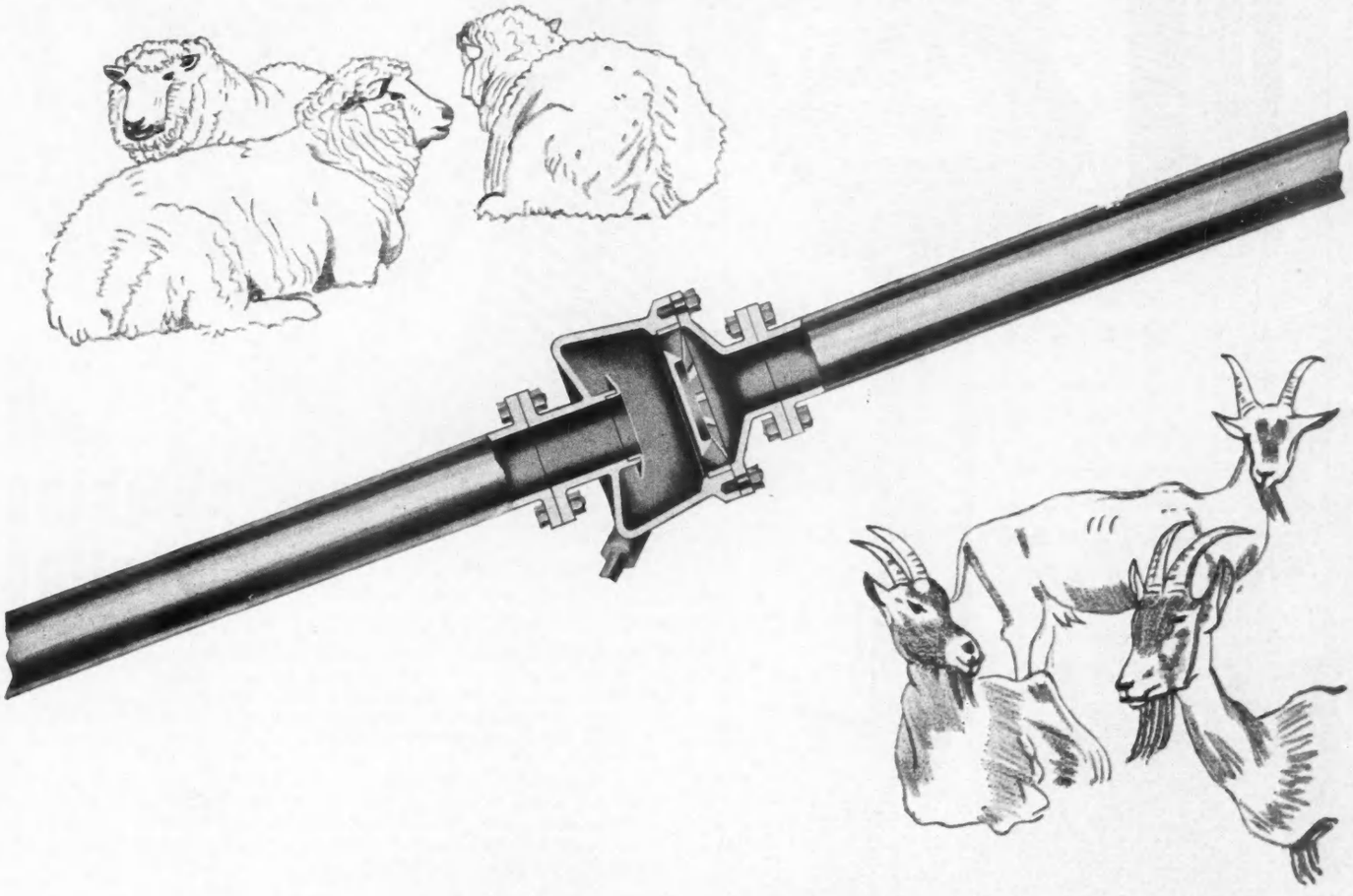

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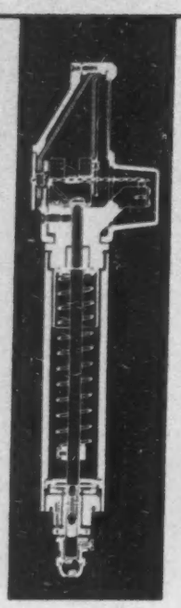

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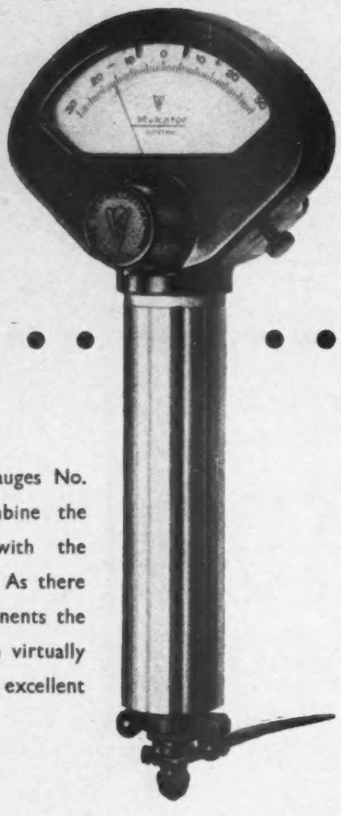

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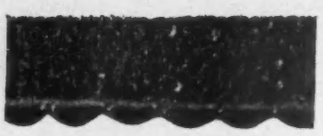

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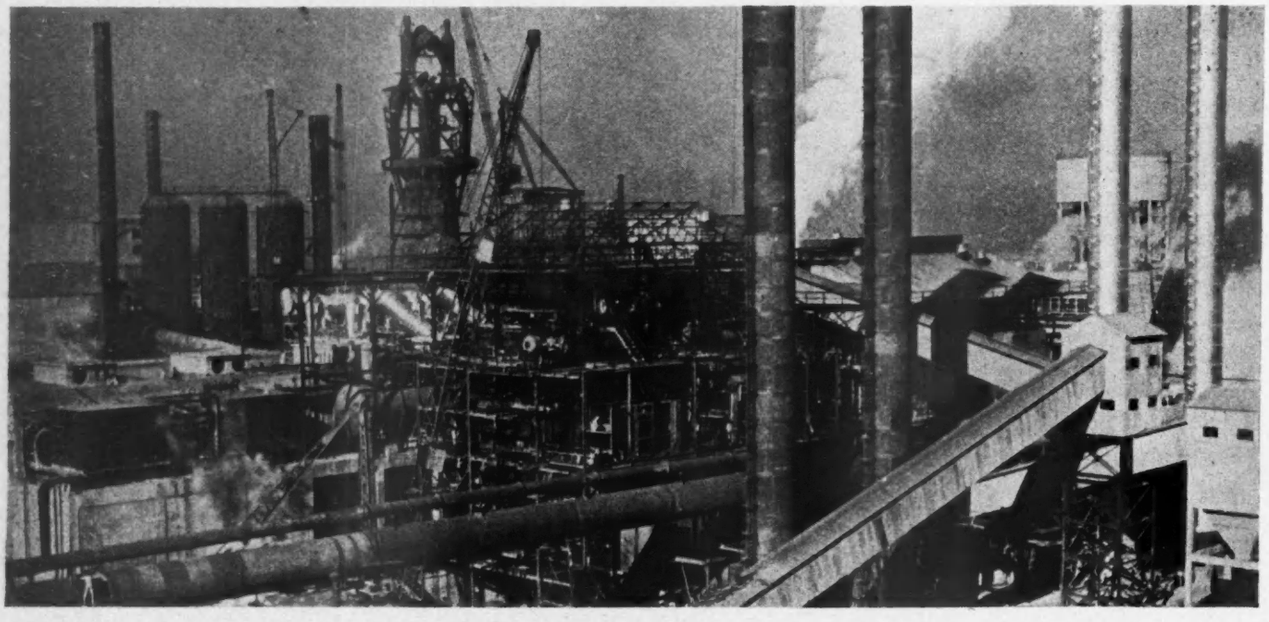

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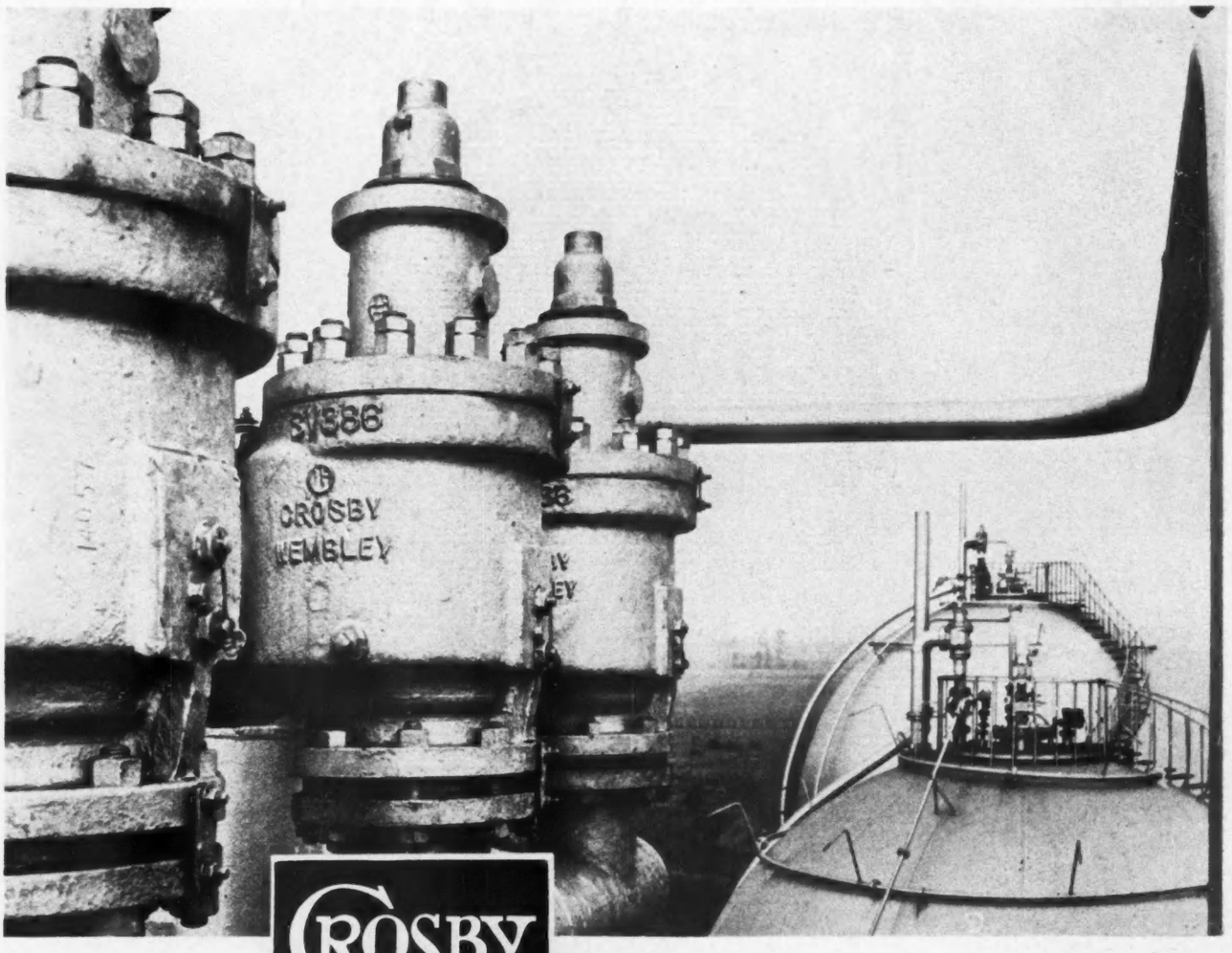

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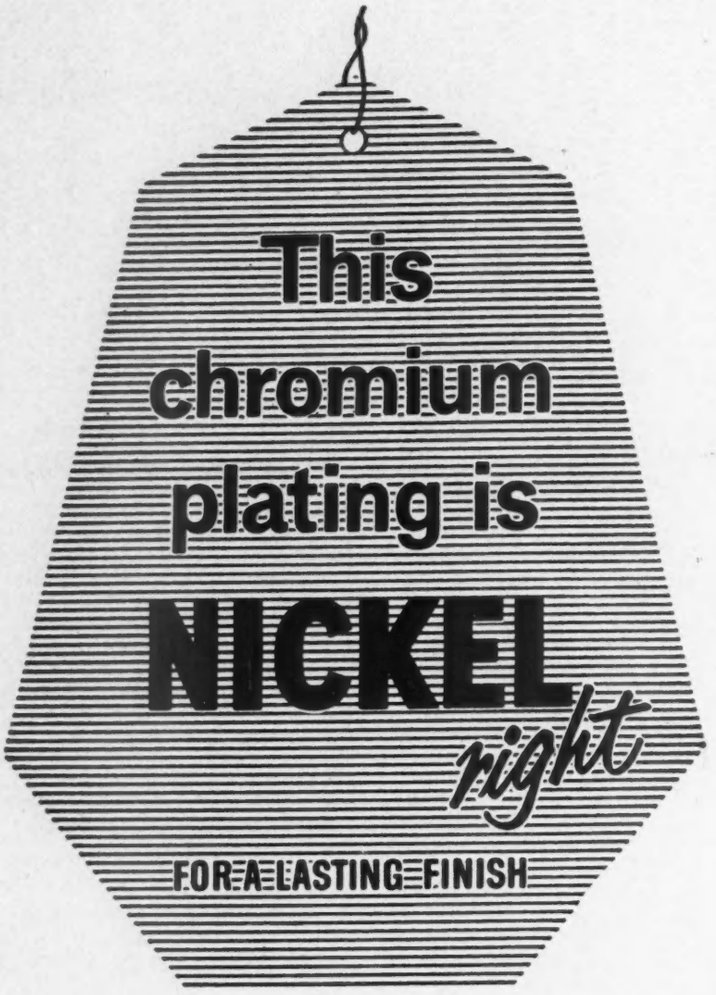

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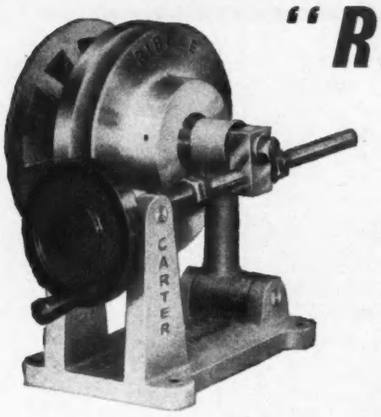

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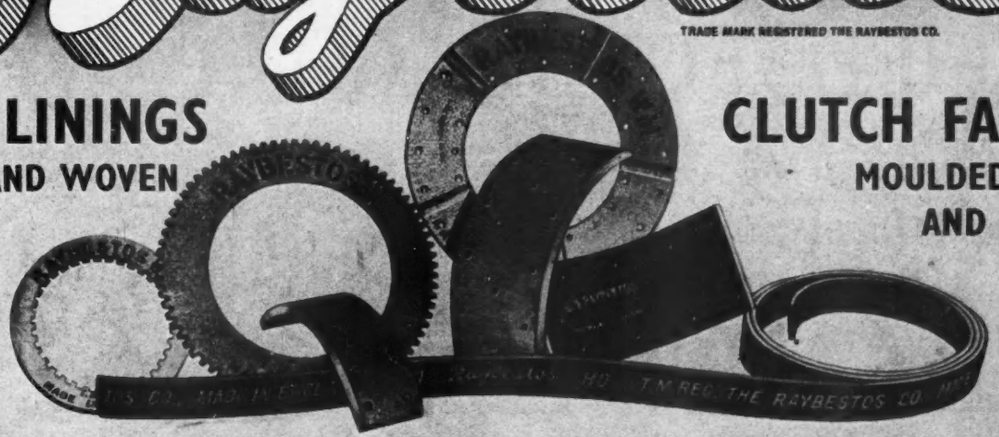

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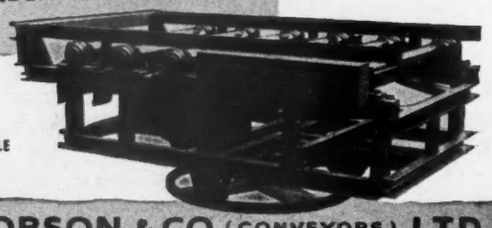

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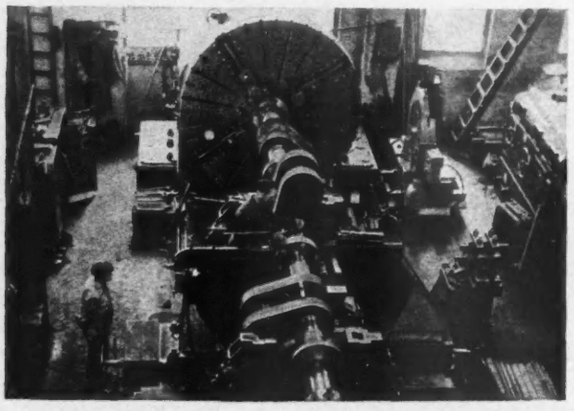

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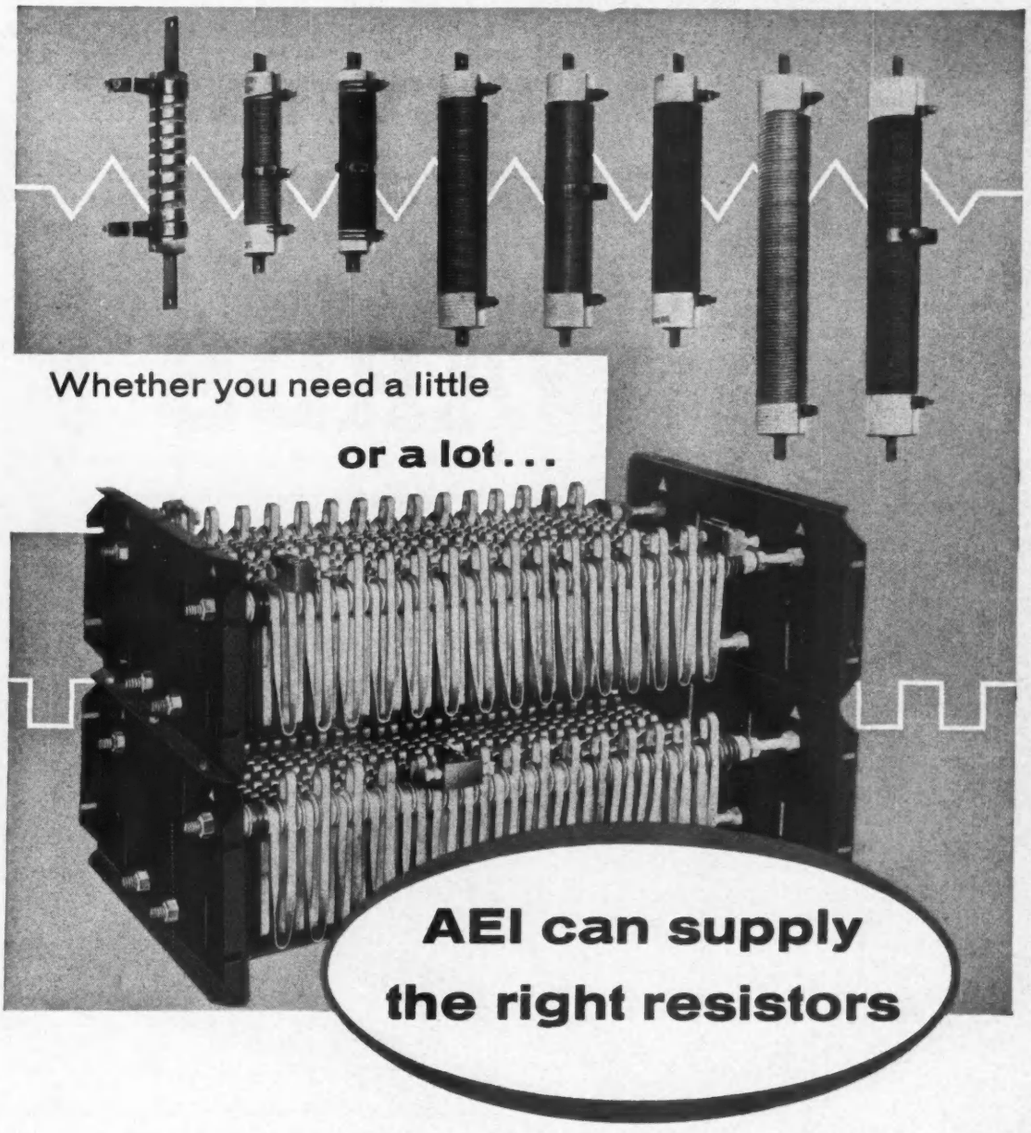

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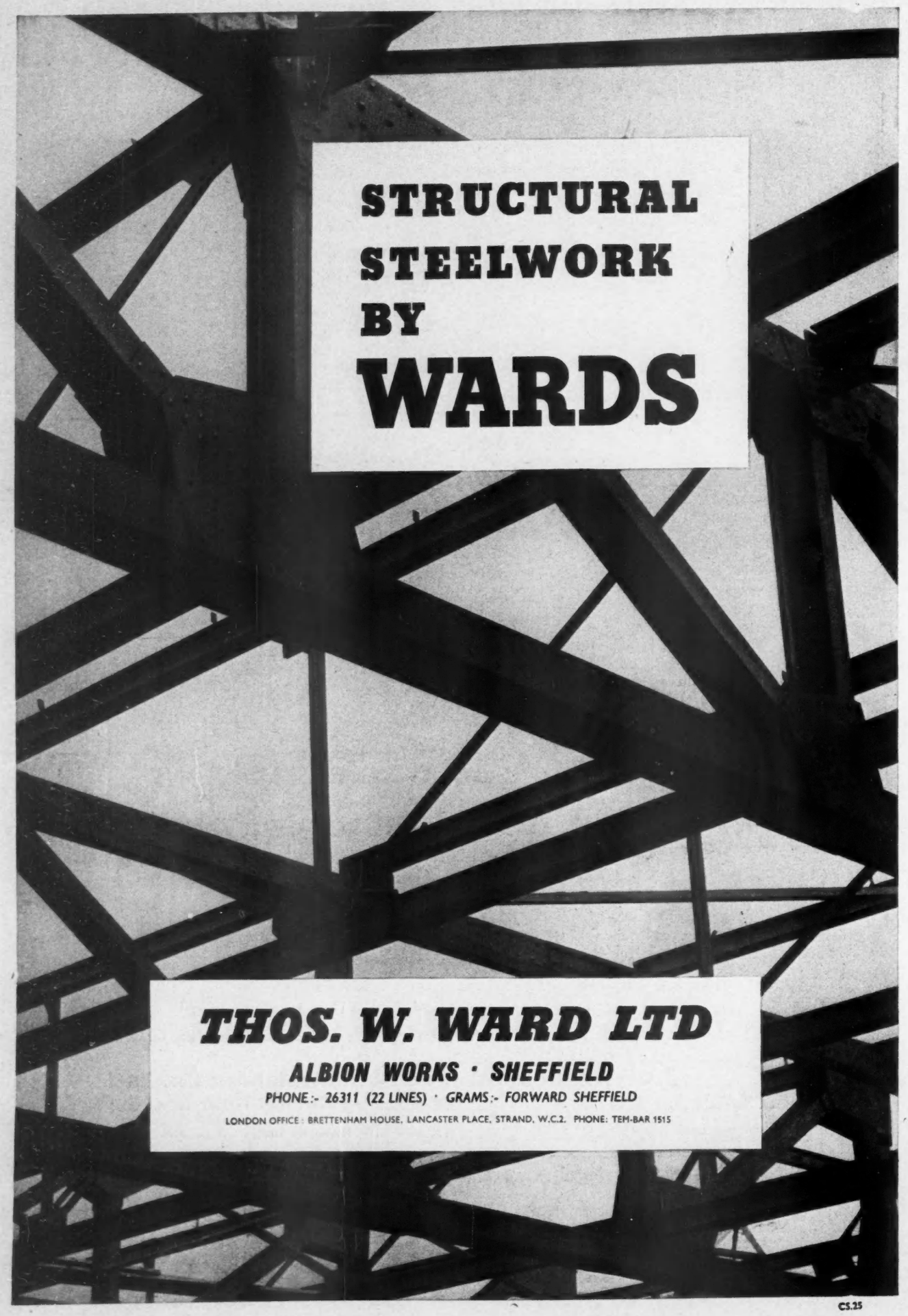
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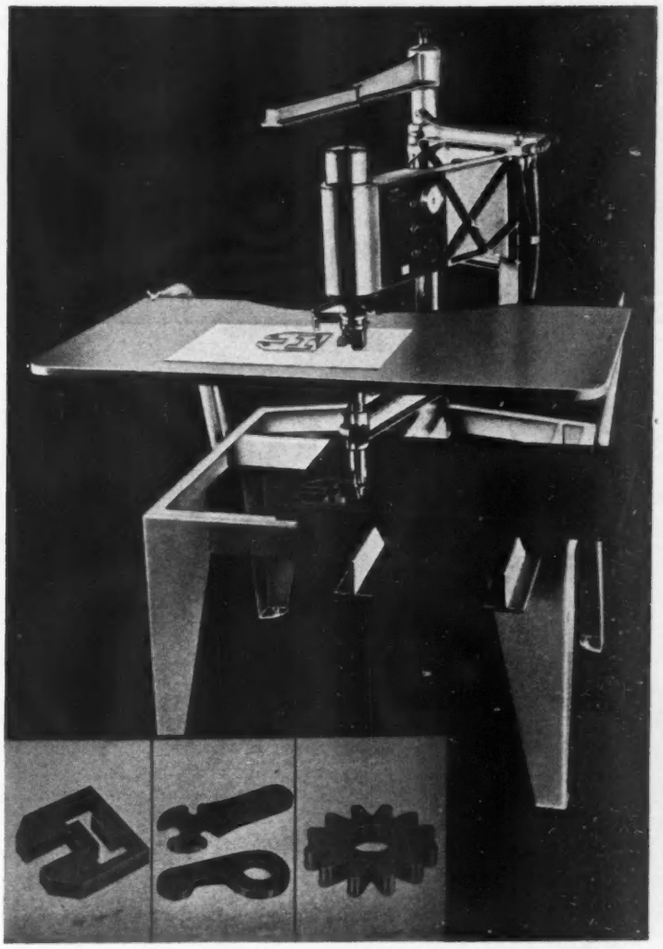

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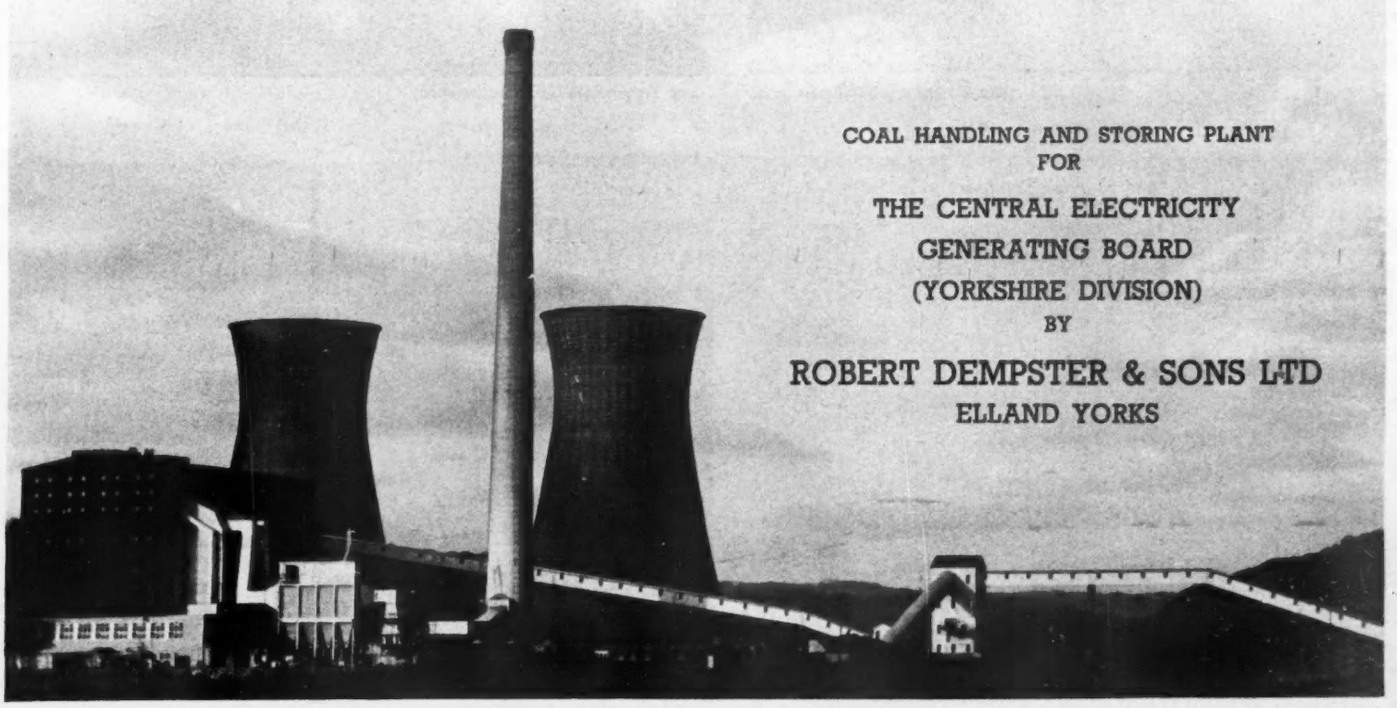

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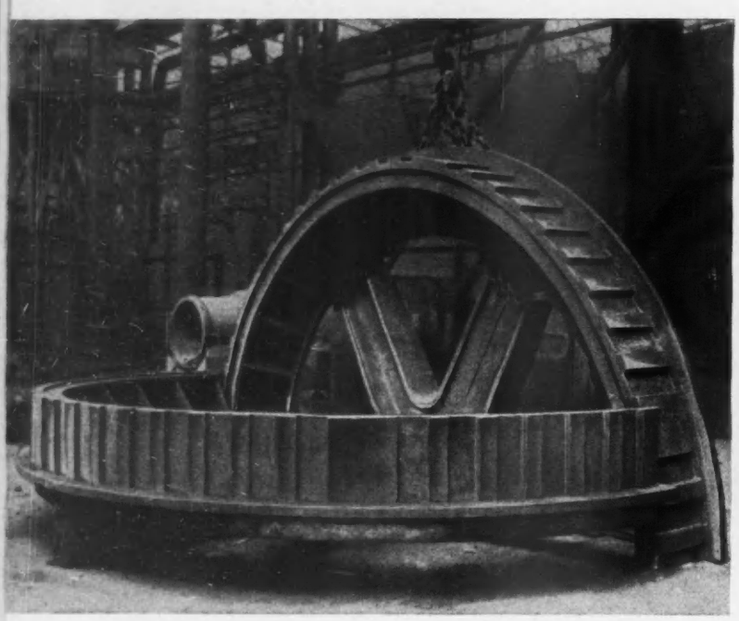

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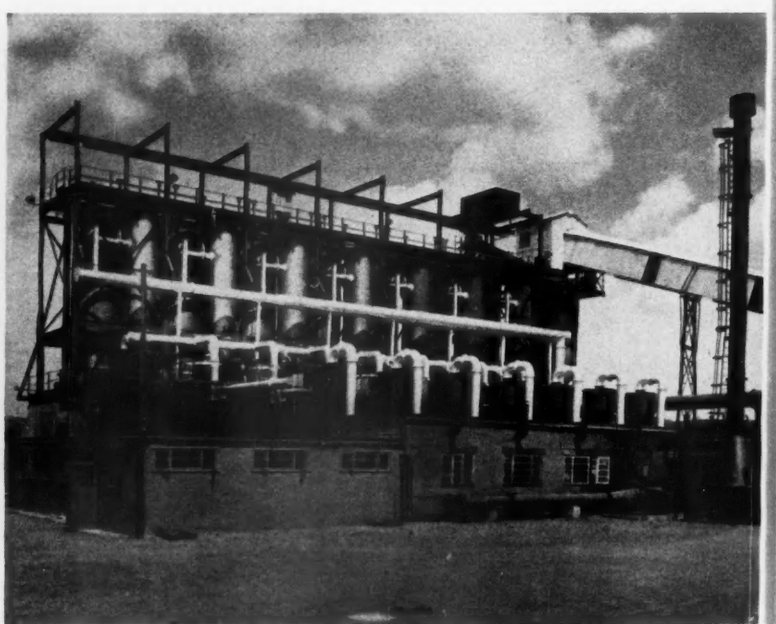

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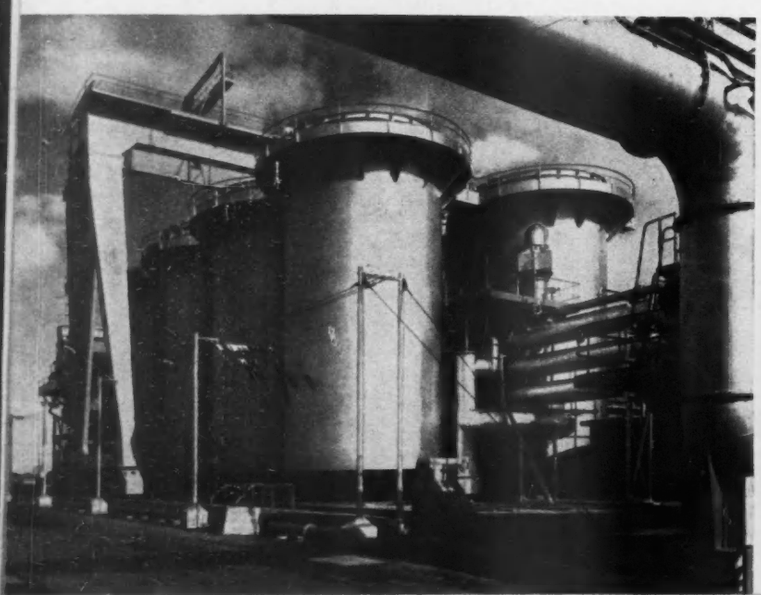

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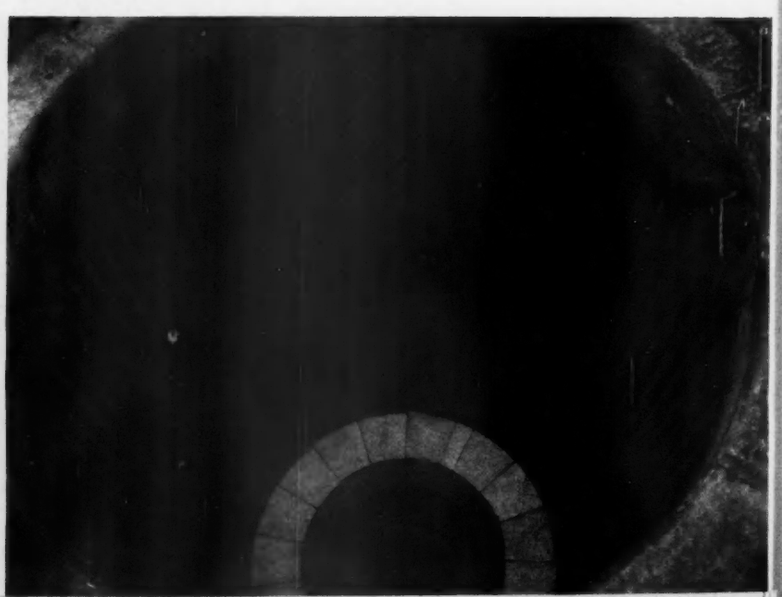

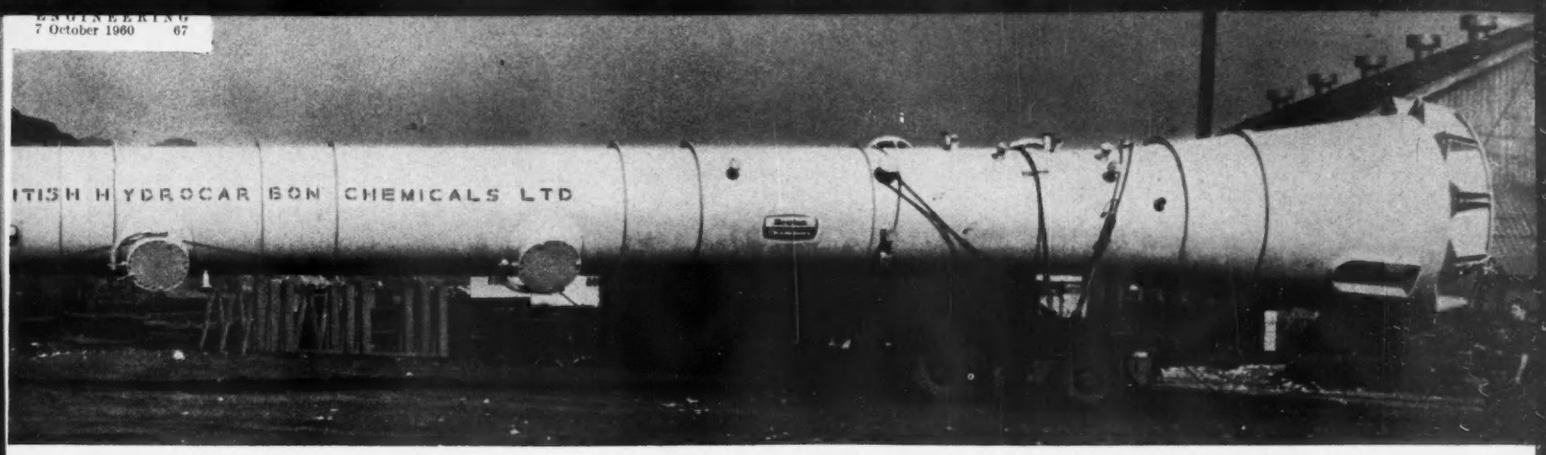

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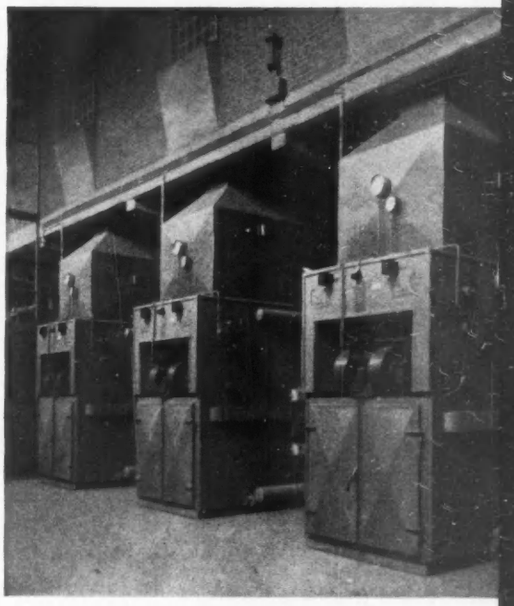

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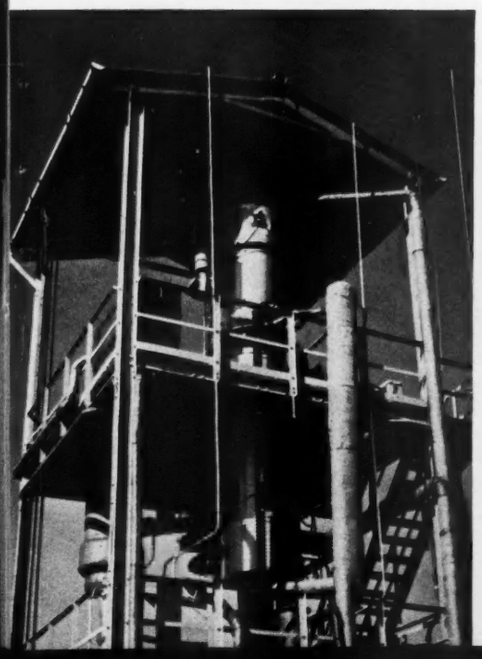
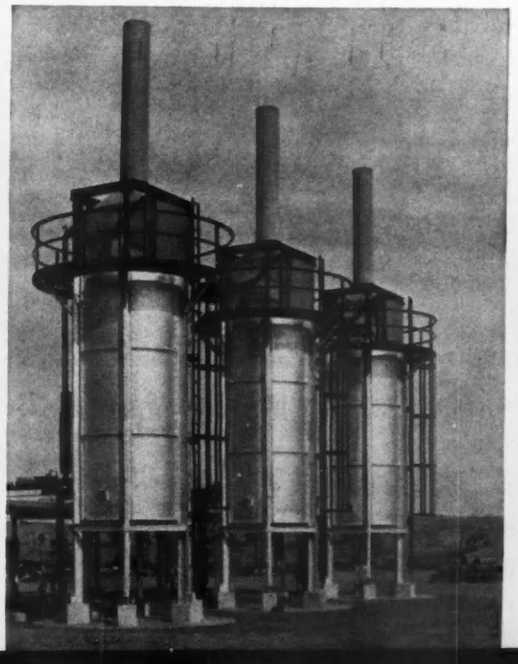


Struthers Wells direct-fired heaters



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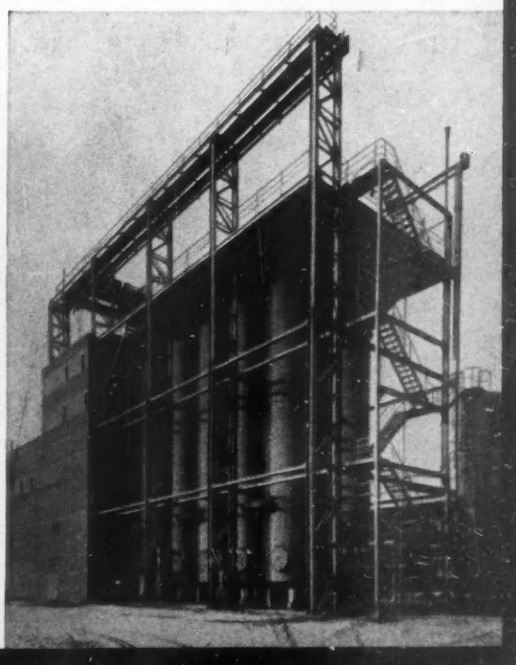

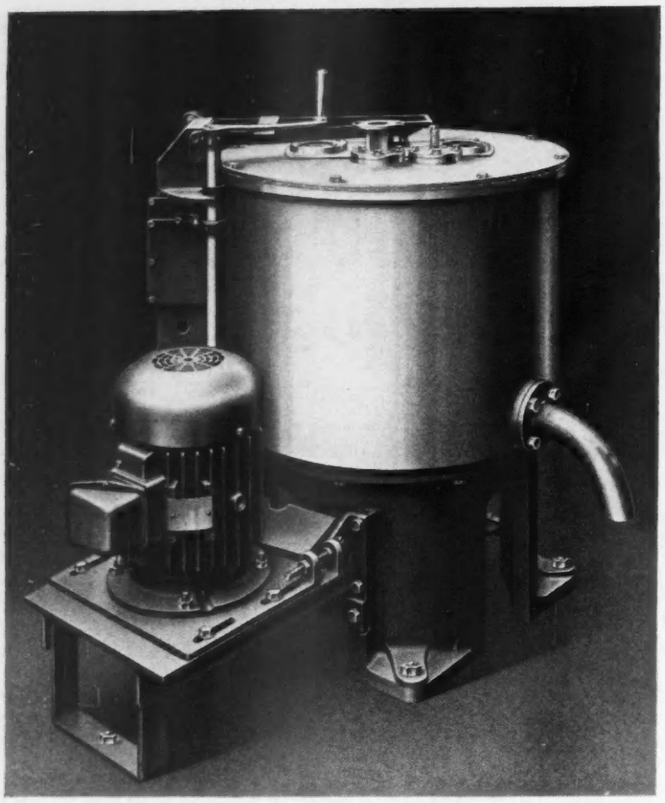

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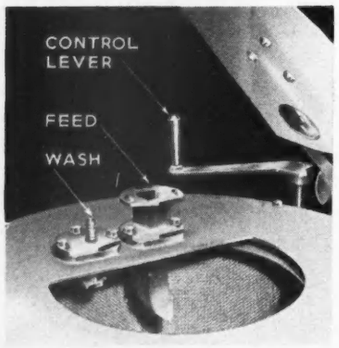

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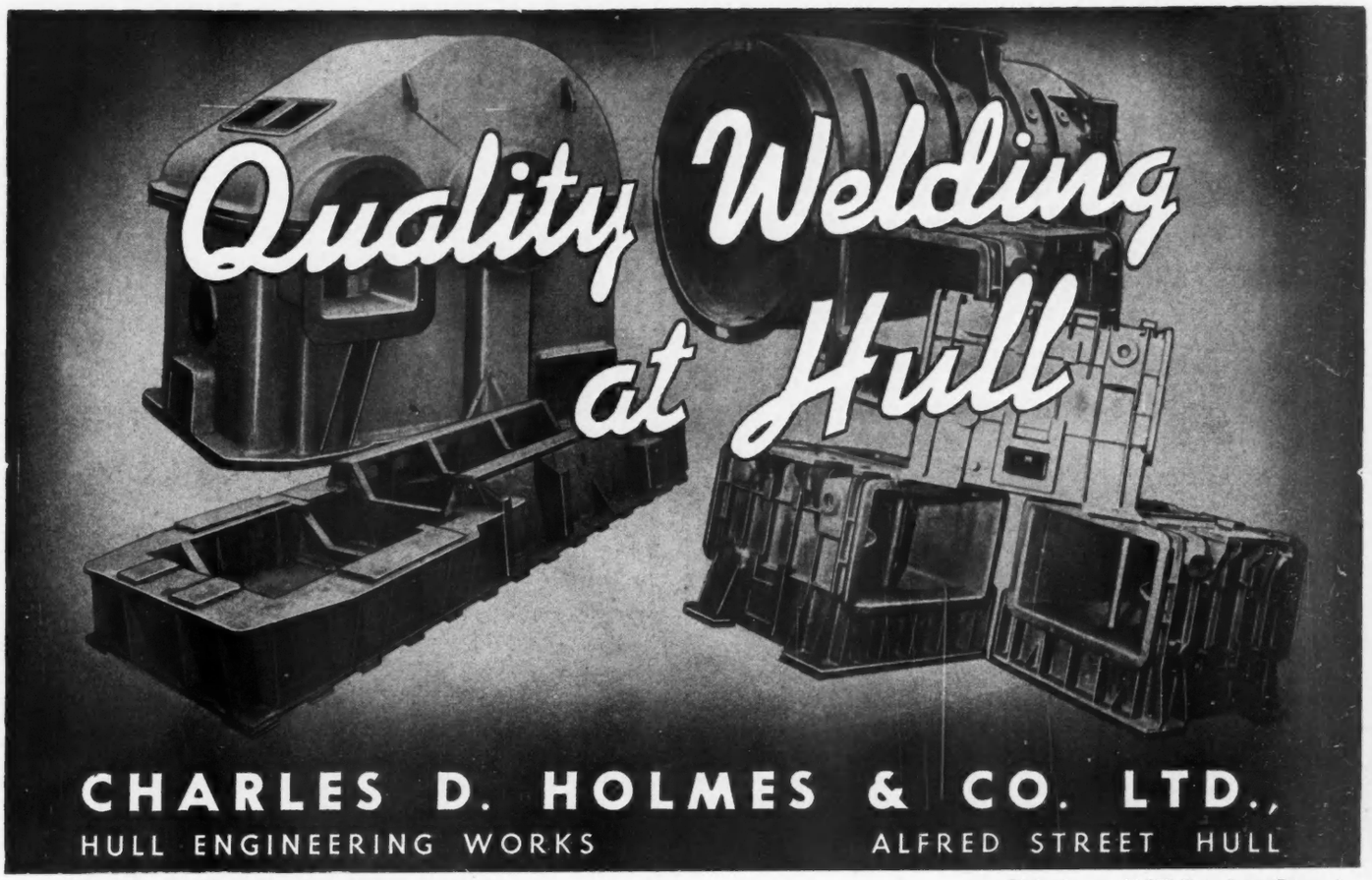

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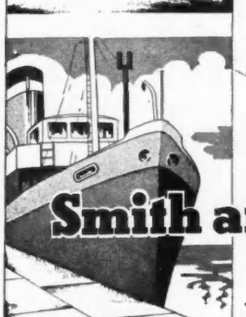

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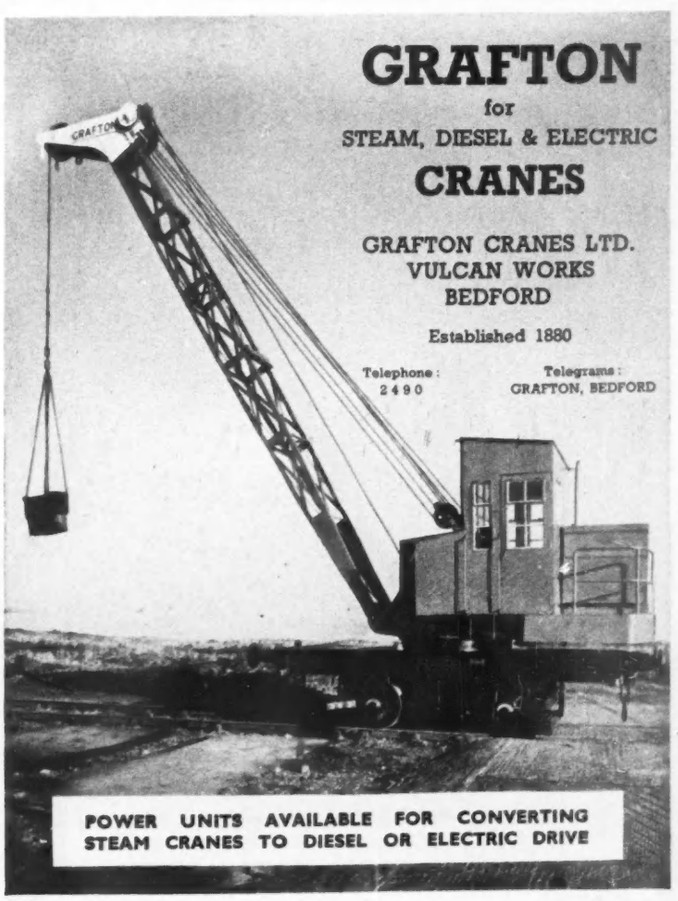

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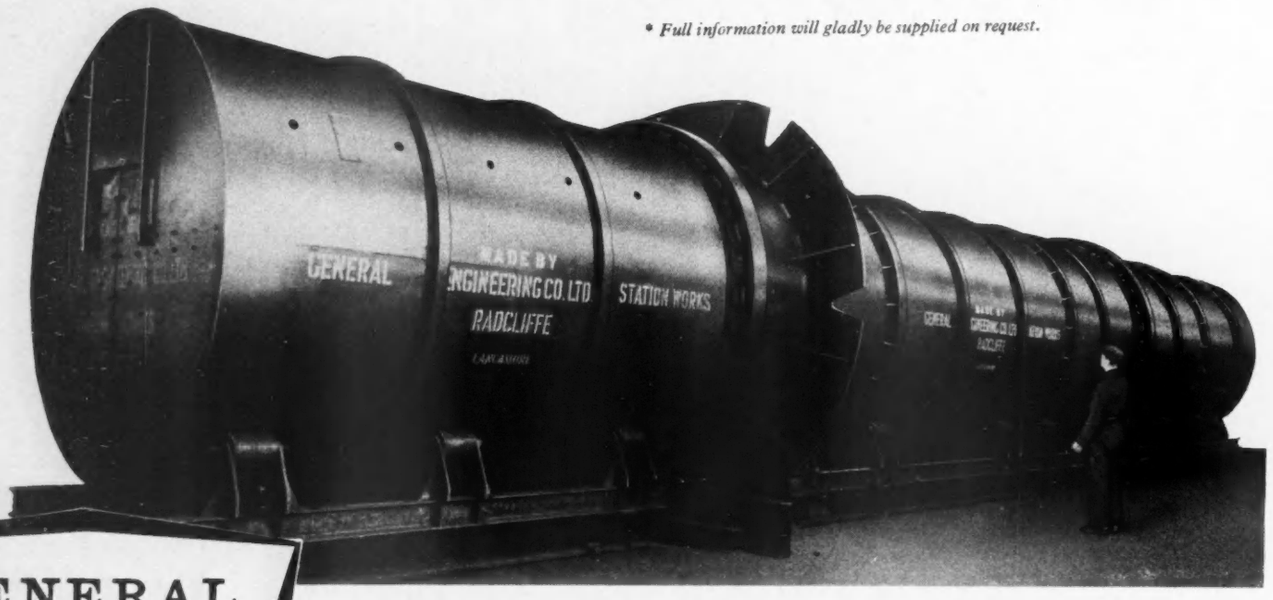

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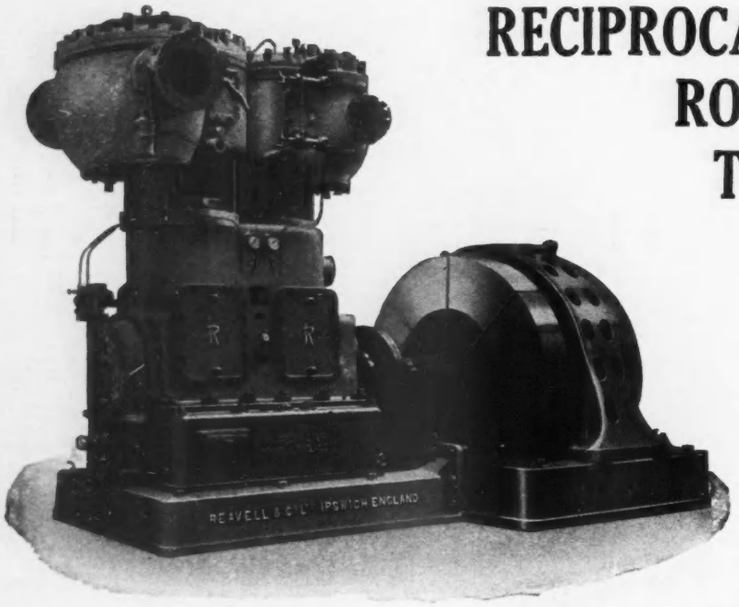

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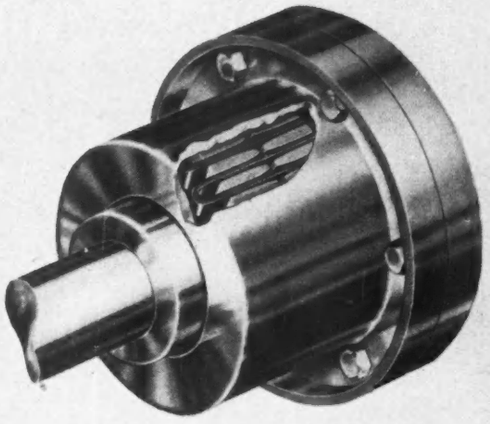

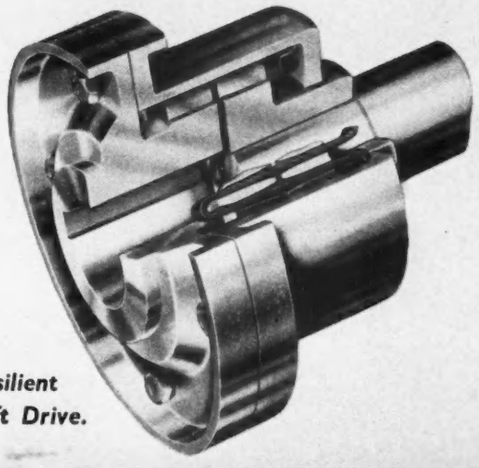

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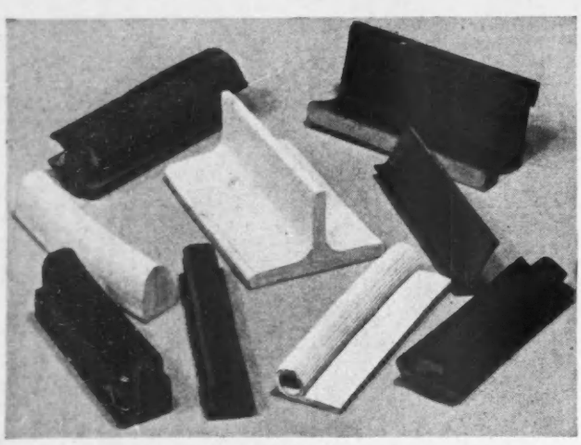

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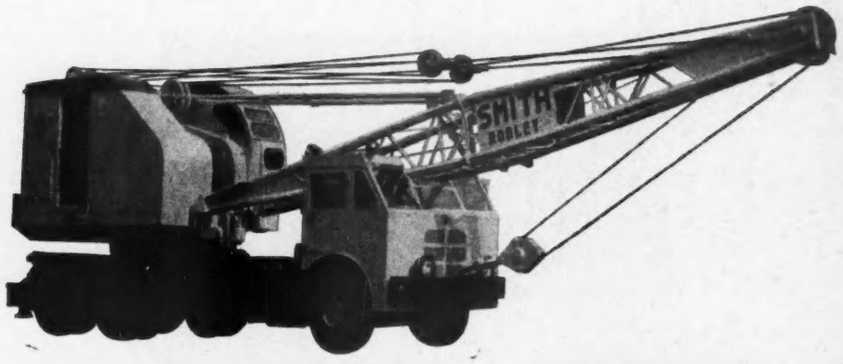

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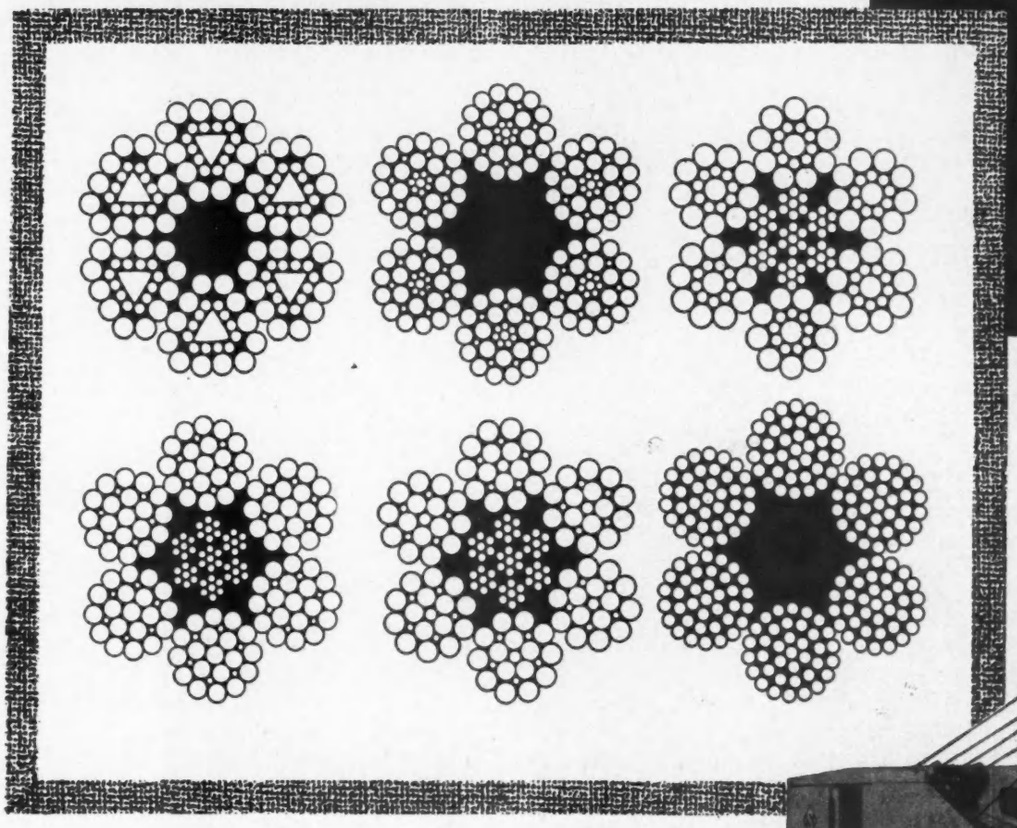

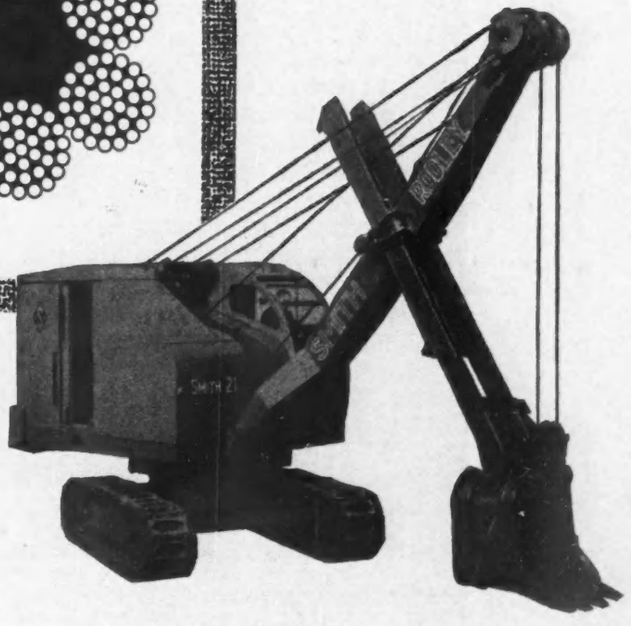

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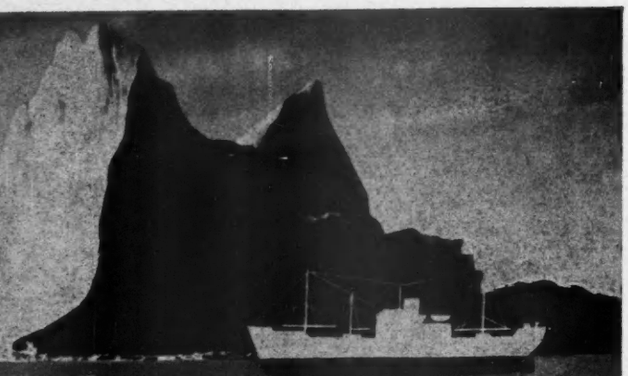

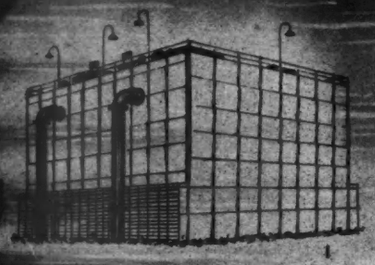

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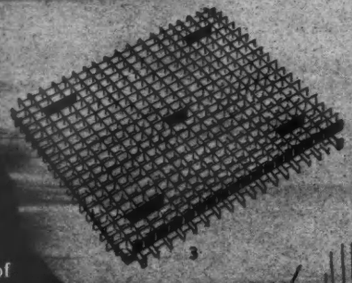

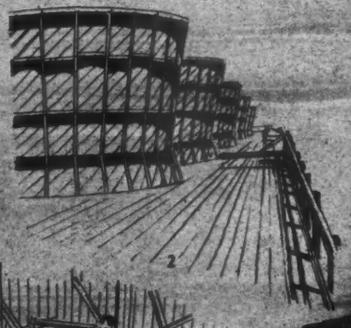

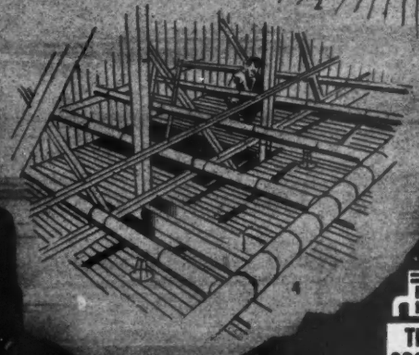

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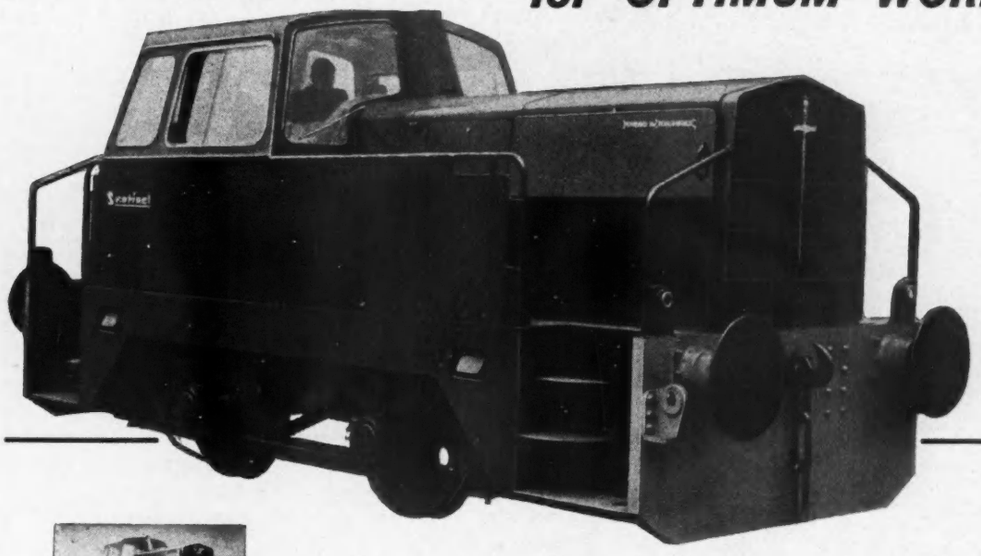

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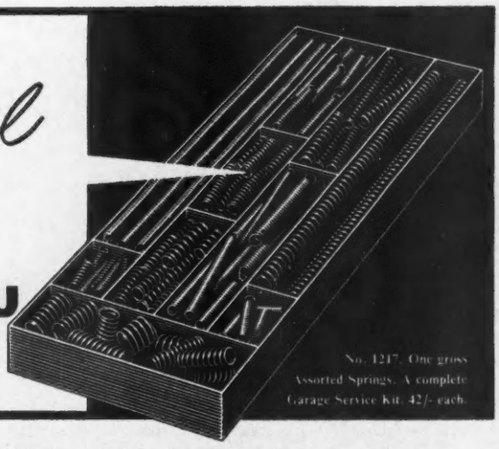

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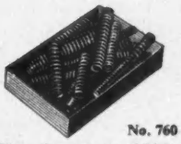

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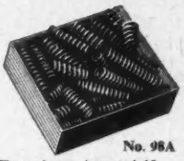

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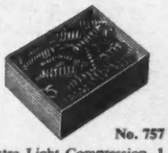

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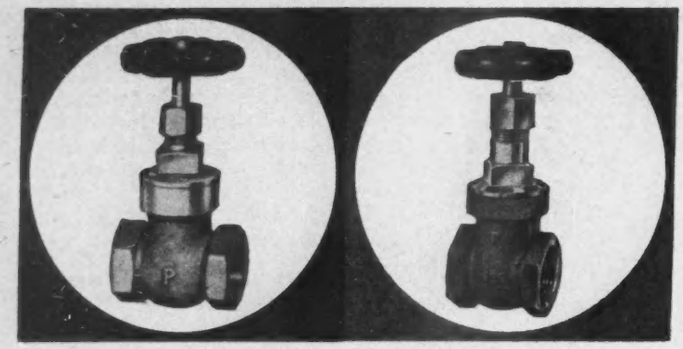

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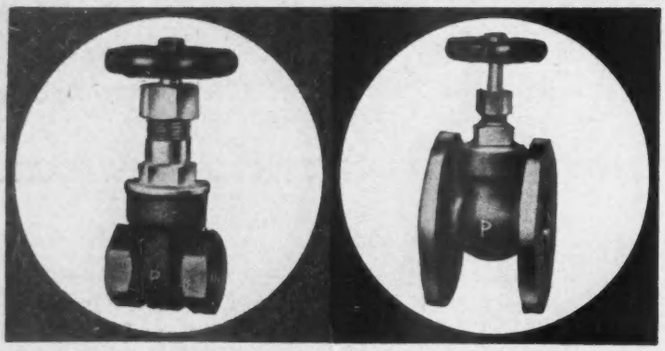

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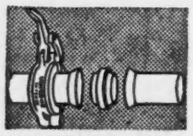
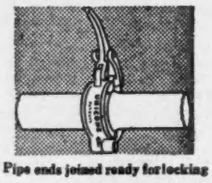
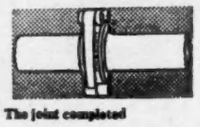

Rubber gasket in position and joint ready to pull over


Pipe ends joined ready for locking


The joint completed

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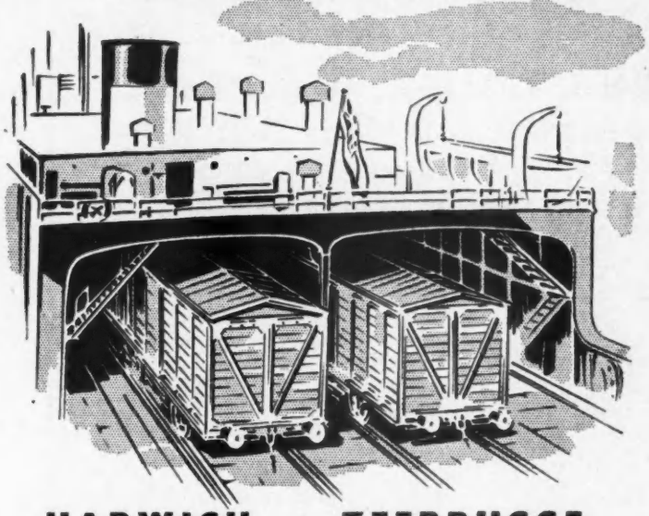

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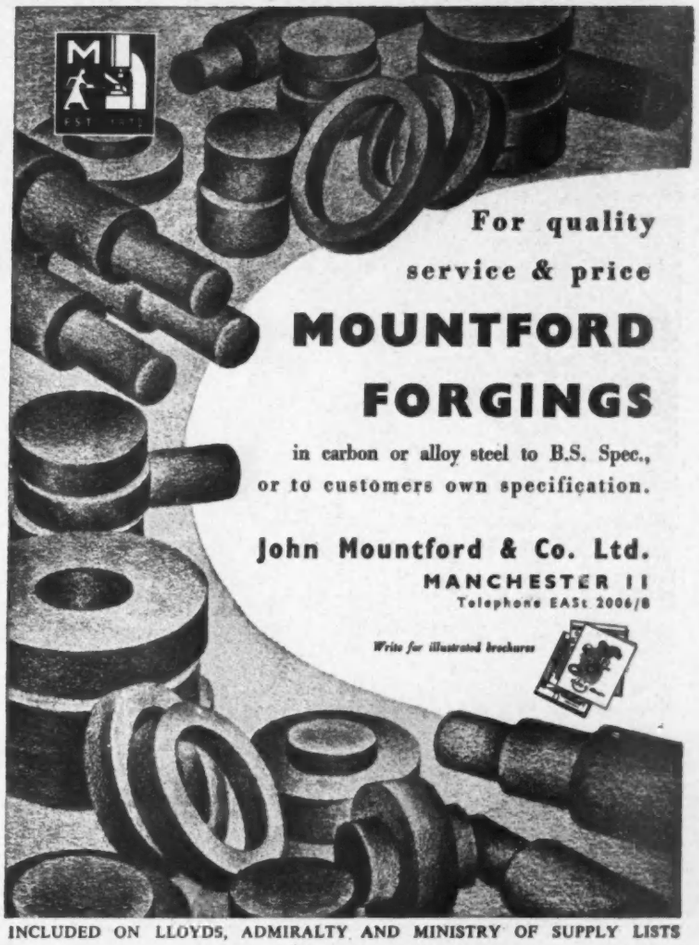

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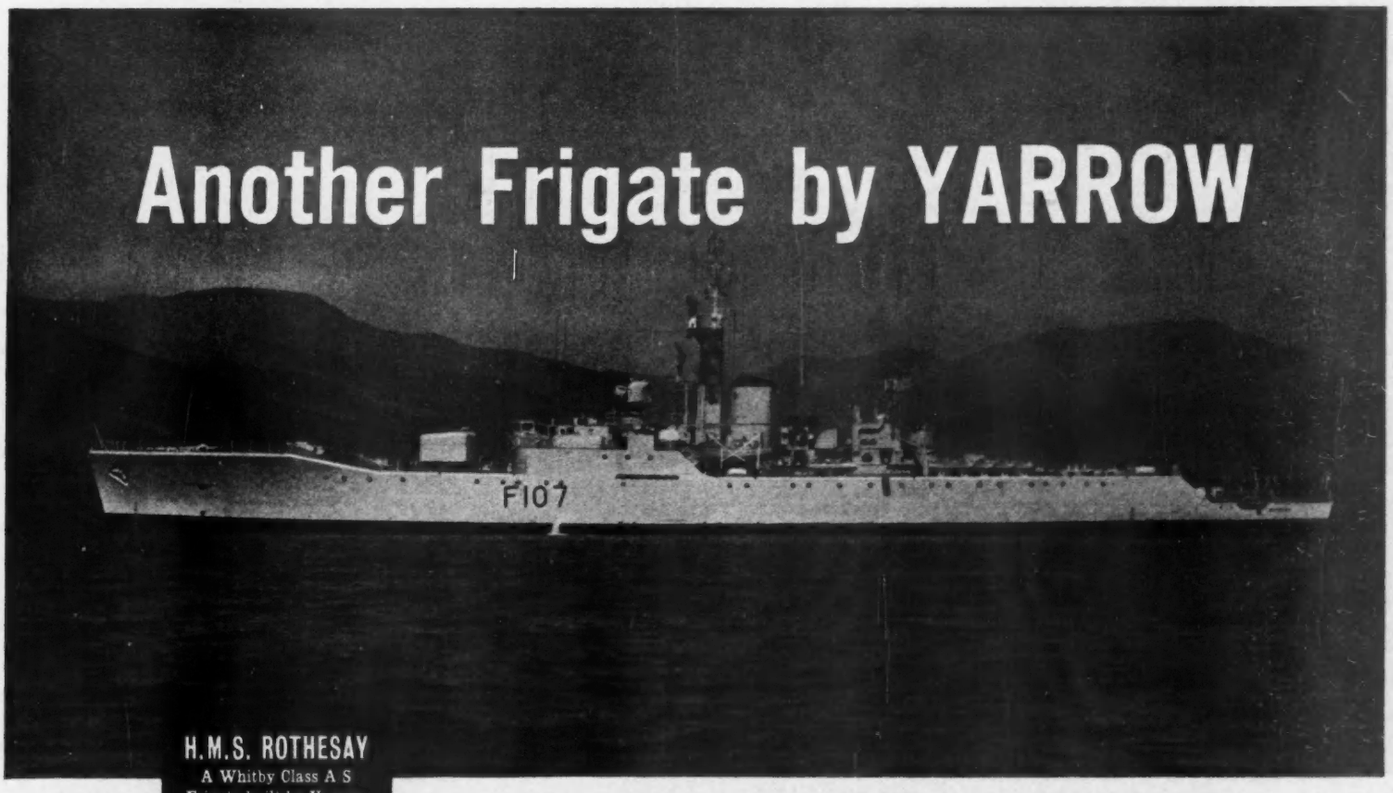

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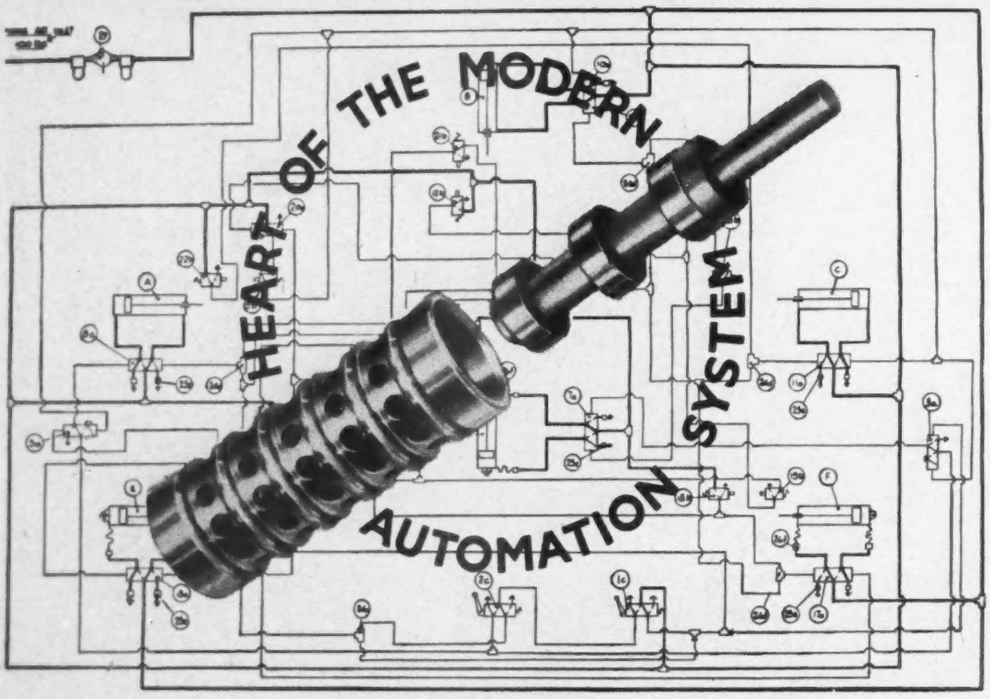

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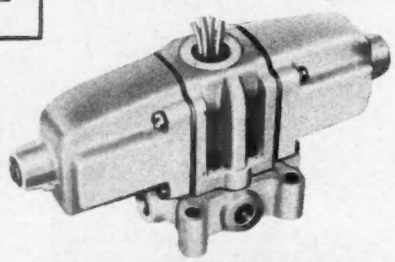

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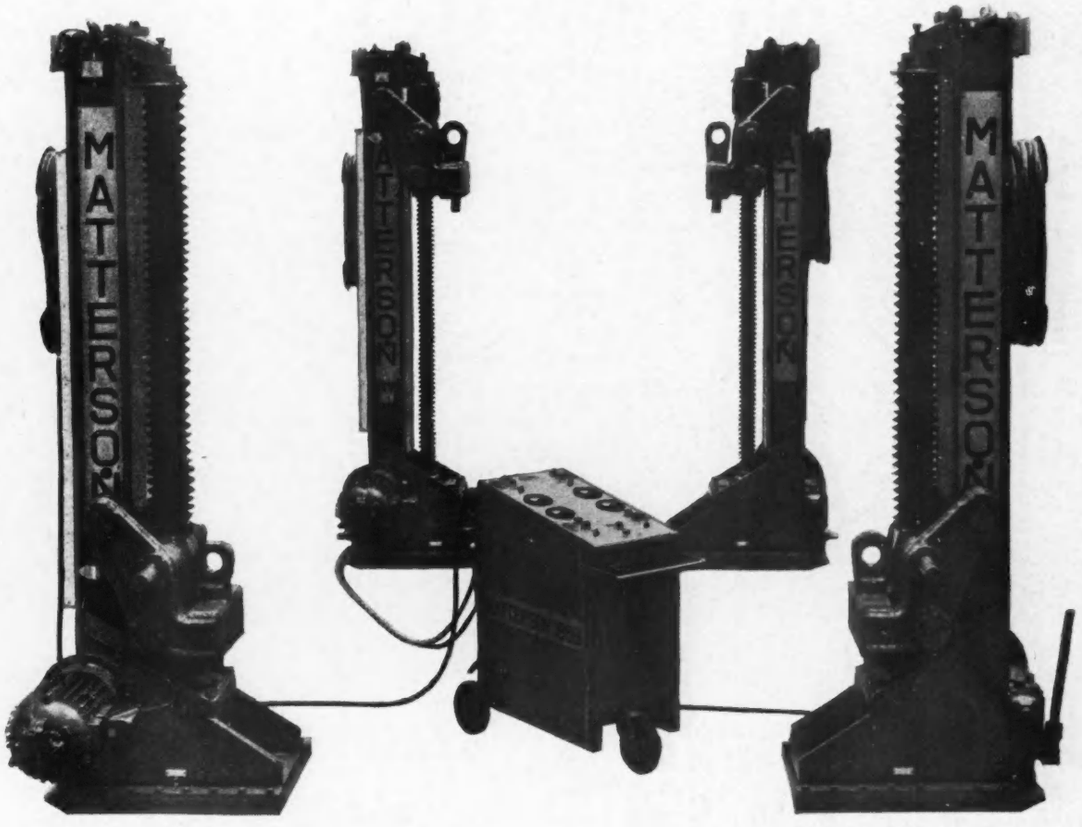

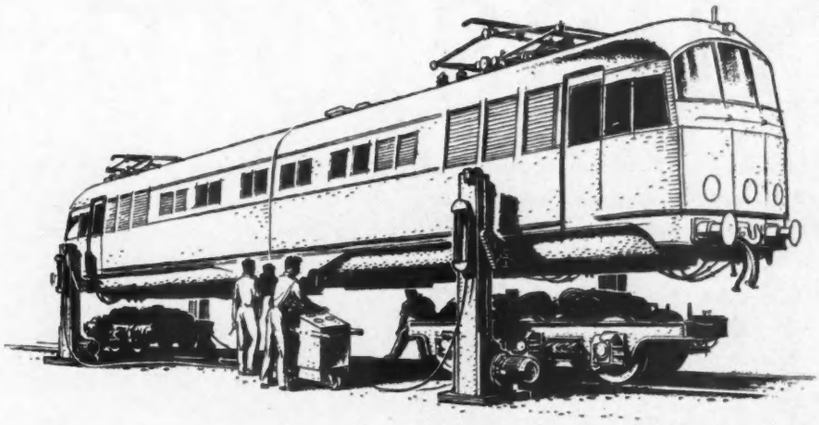

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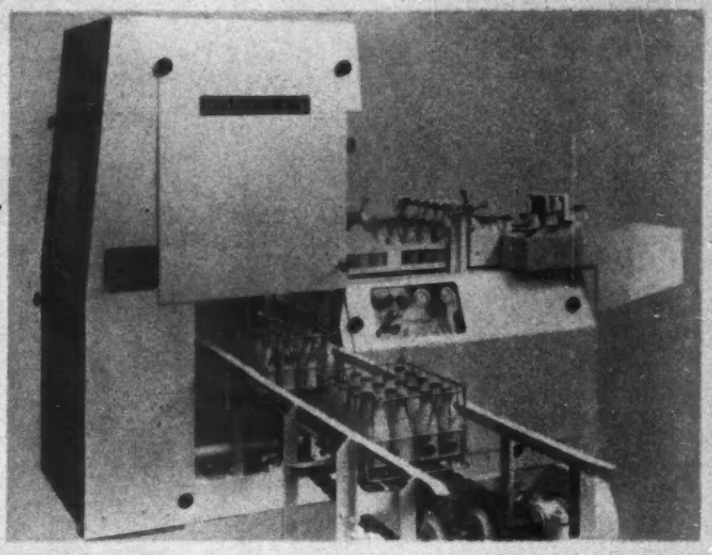

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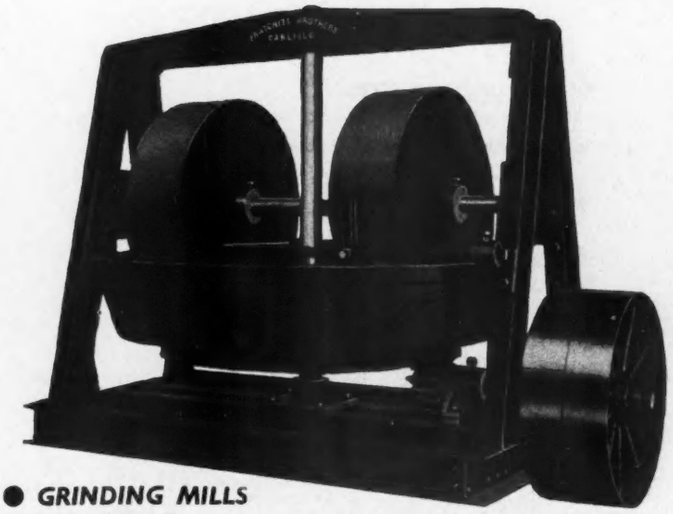

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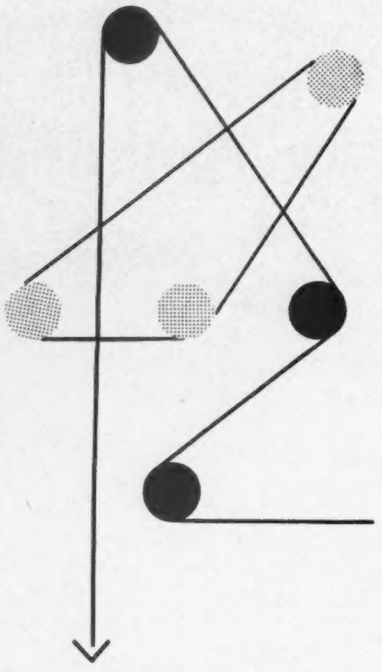

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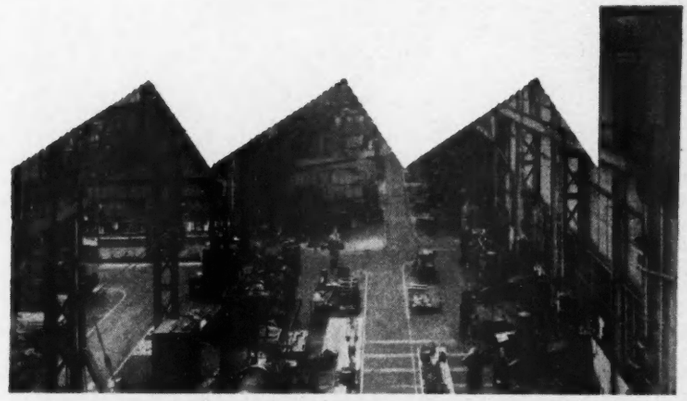

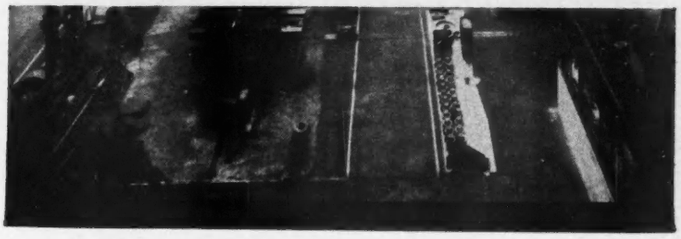

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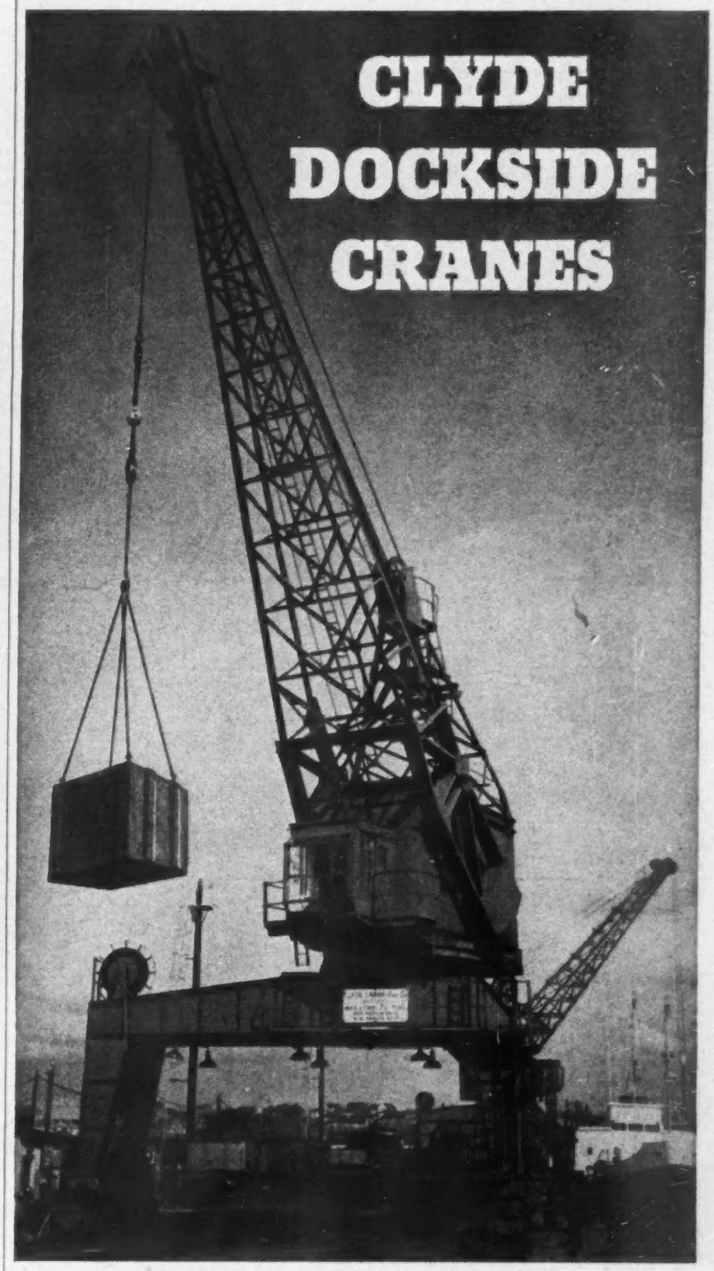

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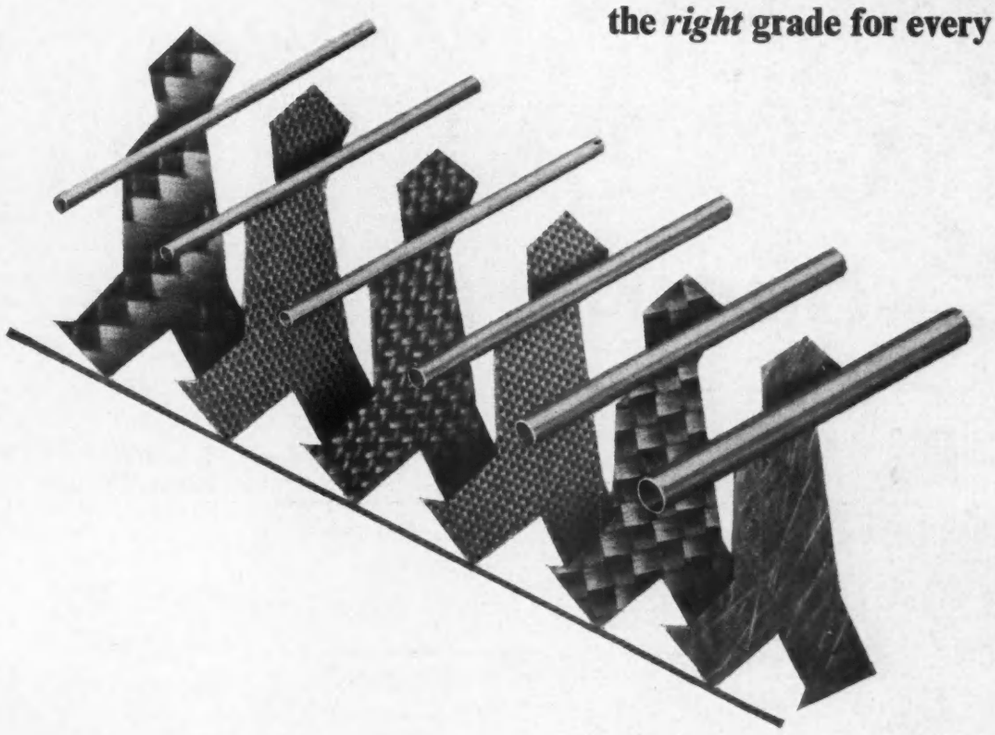

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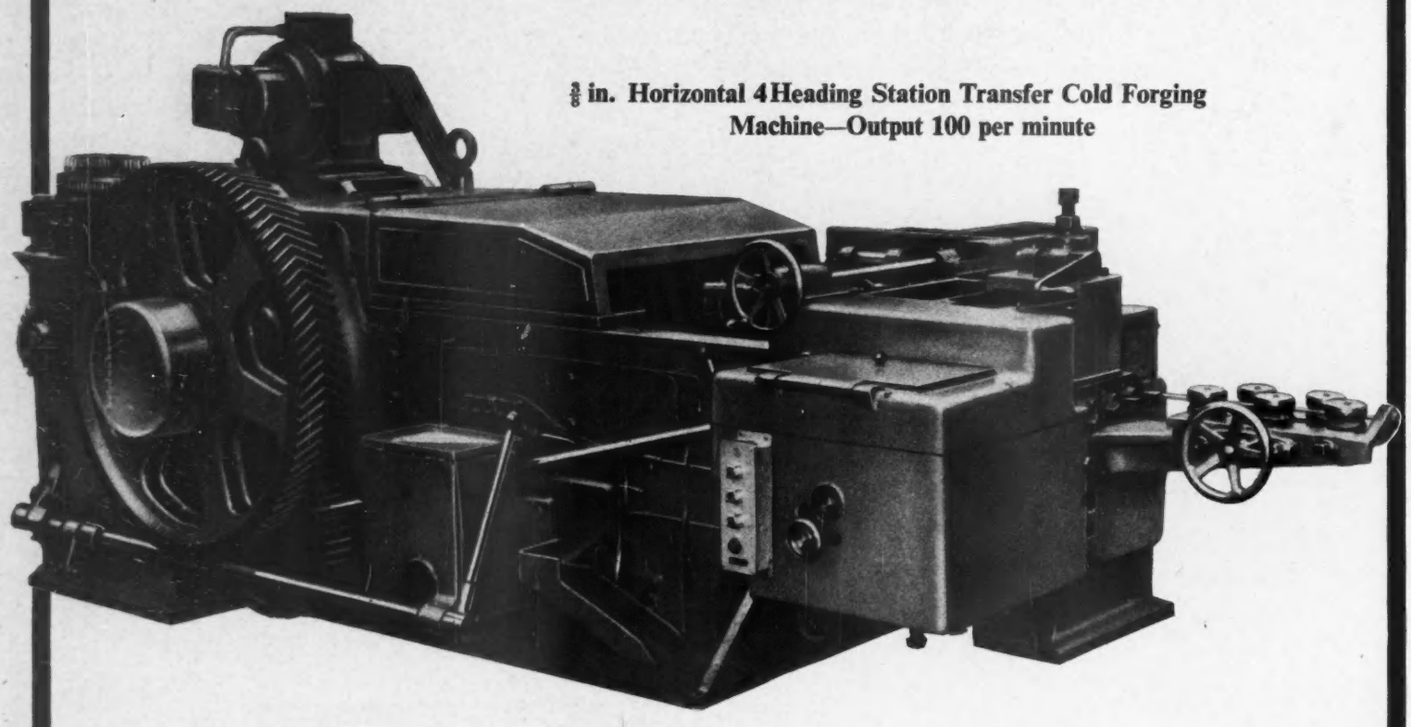

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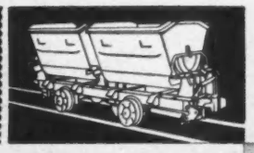

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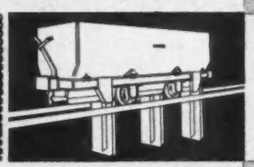

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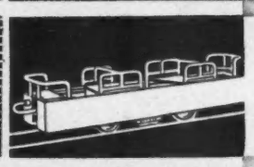
This car is designed for coal handling (up to 5½ tons capacity) and ore handling (up to 20 tons capacity). Maximum efficiency is obtained on rail gauges in excess of 36".

D23



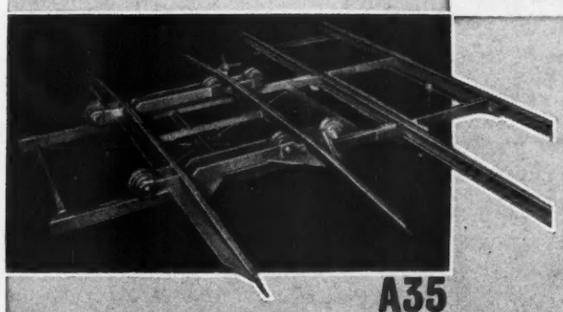
MAN RIDING CAR

This car can be fitted with automatic emergency braking systems of the compressed air type for loco operation or hydraulic for rope haulage installations.

D21

WELL-BOTTOM CAR

This 85 cu. ft. capacity car is fitted with "TEKO" Wheels and Axles and Special Drawbar and Shackles.



A35

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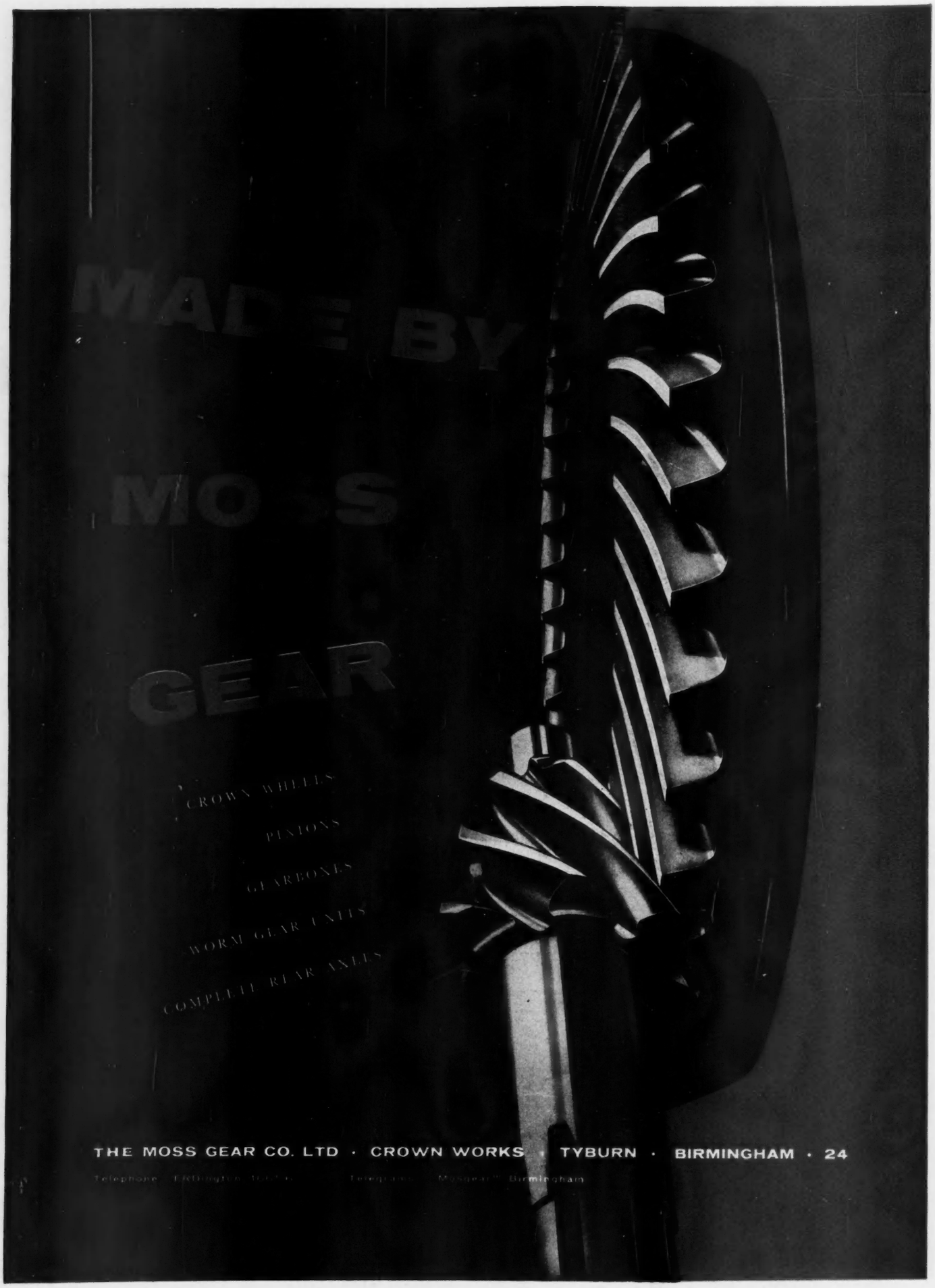
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